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THE CLASSIFICATION OF COAL

BY

SAMUEL W. PARR

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THE CLASSIFICATION OF COAL

I. Introduction

1. *Introduction.*—Solid fuels of any sort are complex in character; hence the impossibility of assigning to the various types exact physical or chemical properties by which they may be known and set off into distinct groups. For example, solid fuels as a whole may be divided into three general classes, wood, peat, and coal, but each type has many variables within its own range, while the border line between types becomes dim if it does not fade out altogether.

In 1821 the total output of coal in the United States was 1322 tons, all anthracite. There was a period, therefore, in this country when wood was the dominating fuel. Indeed, previous to 100 years ago, over 95 per cent of the fuel used was wood, and a classification quite sufficient for the period involved hardly anything more than a designation of the variety of tree from which the wood was derived. "Shell-bark Hickory" or "Hard Maple" or "Pine" were terms sufficiently distinctive to serve the purpose of classification for the kind of fuel then most generally used. However, at the present time neither wood nor peat have any status as a fuel, because of the abundance and cheapness of our coal supplies. This may be the more readily appreciated when it is noted that in the United States the present annual output of coal of all classes amounts in round numbers to approximately 600 000 000 tons. This tonnage represents an aggregate value at the mines of approximately one and three-fourths billion dollars.

The magnitude and importance of this commodity are alone sufficient to indicate the need of some system of classification which would at least serve the purposes of description or of reference and study, all of which show a marked growth in magnitude and importance somewhat commensurate with the growth in production and industrial significance of the coal output of the country.

2. *Acknowledgments.*—The scheme of classification here set forth has resulted from experiments and studies at the University of Illinois extending over many years and taken part in by many individuals, both students and instructors. The list of names would be a long one if an attempt were made to reproduce them all. Special acknowledgment, however, should be made to Elmer B. Vliet, for the use of his calculations and data for his master's thesis. Special reference should also be made to the work of Floyd B. Hobart who has assembled the

data and prepared the charts, and without whose help this presentation would have been impossible.

The investigation has been carried on as a part of the work of the Engineering Experiment Station, of which DEAN M. S. KETCHUM is the director; and is one of the researches in Applied Chemistry carried on under the direction of PROFESSOR D. B. KEYES, Professor of Industrial Chemistry.

II. HISTORICAL SKETCH OF COAL CLASSIFICATION

3. *Former Methods of Classification.*—In each coal producing country a method of classification came into vogue which was a direct development of methods of study or trade requirements peculiar to the several coal producing regions. Regnault in France was probably the first chemist to make ultimate analyses of coal, and the Grüner system of classification utilized the values thus obtained, especially the percentages for carbon, hydrogen, and oxygen. He drew his conclusions as to type from percentages of total carbon and also from the ratio of oxygen to hydrogen. Wedding in Germany put more stress on the percentage of volatile matter. In England in the earliest conception as set forth in Ure's "Dictionary of Arts, Manufactures, and Mines" (1846) under "Pitcoal," and also in the older editions of Watt's "Dictionary of Chemistry," the terms used for designating different coals were not chemical, but almost wholly derived from physical properties and industrial uses; hence the introduction of terms which still have a place in coal technology, such as cubical, cherry, caking, splint, non-caking, glance, etc. In recent years Seyler has rescued the English coals from a terminology almost meaningless, at least to the foreigner, and inaugurated a scientific method based on chemical values.

In America the first suggestion of a basis for classification is found in the report of Professor Walter R. Johnson to the United States Navy, printed in 1844 as Senate Document 386.

"This report constituted a book of 606 pages and gave in detail the data connected with complete evaporative tests on forty-three samples, three of which were shipments from England, Scotland, and Nova Scotia, and one was American wood. In setting forth the results, 200 tables were required which for the most part were double page in size. In one of these tables, Johnson, following a propensity which characterized many of these tables put his results in the form of a ratio and in this particular table the coals tested are arranged in the order of the ratios of the fixed carbon to the volatile matter and this ratio is shown to have a constant relation to the evaporative power of the fuels tested. Here, it will at once be seen, originated the term 'Fuel-Ratio' which in a general way serves as an index of coal values."*

It remained for Professor Persifor Frazer, however, to indicate the true significance of this ratio. Professor Frazer's paper, in which he proposed a scheme of coal classification based on Johnson's idea of fuel ratios, was read at the Wilkes-Barre meeting of the American Institute of Mining Engineers for 1877, and the terms there proposed have stood substantially unchanged to the present time. It is interesting to note in this connection that for the 25 years following the publication of Professor Frazer's paper, studies on coal were very meagre; while in the next 25 years, immediately following the organization of the United States Bureau of Mines and other agencies, a very marked impetus in the matter of coal investigation was begun, so that at the present time a mass of data has accumulated which suggests the possibility of extending, or better, perhaps, reconstructing, our basis for coal classification in a manner which would have been impossible in the earlier years.

It is not intended here to review in detail the discussions on coal classification which have been a marked characteristic of the literature of fuel technology. Campbell, Grout and Ralston have had access to and made excellent use of a mass of present-day analytical values and have presented the topic largely from the scientific standpoint. Ashley has made numerous propositions for what he terms a "use classification" of coal. A discussion of the merits of these various propositions cannot be entered into here. A bibliographic list, however, is appended which will be found valuable to any one who wishes to study the development of the topic of classification. It may be proper, however, to note here that in Bulletin 37 of the University of Illinois Engineering Experiment Station (1909) on pages 35 and 36 are contained substantially all of the basic elements of classification which enter into the system as herein set forth.

III. Fundamental Factors in Coal Classification

4. *Oxygen Content and Volatile Matter.*—One need take only a superficial view of the coal studies in this and other countries to see that there are a few fundamental factors that seem to have been selected to carry most of the burden of determining the specific properties that differentiate the various coals from each other. Among

*Parr, S. W., "Fundamental Studies on Coal." Proceedings of the International Conference on Bituminous Coal, Pittsburgh, 1926, p. 640.
Also Parr, S. W., "A Pioneer Investigator." Jour. Ind. Eng. Chem., Vol. 18, p. 94, 1926.

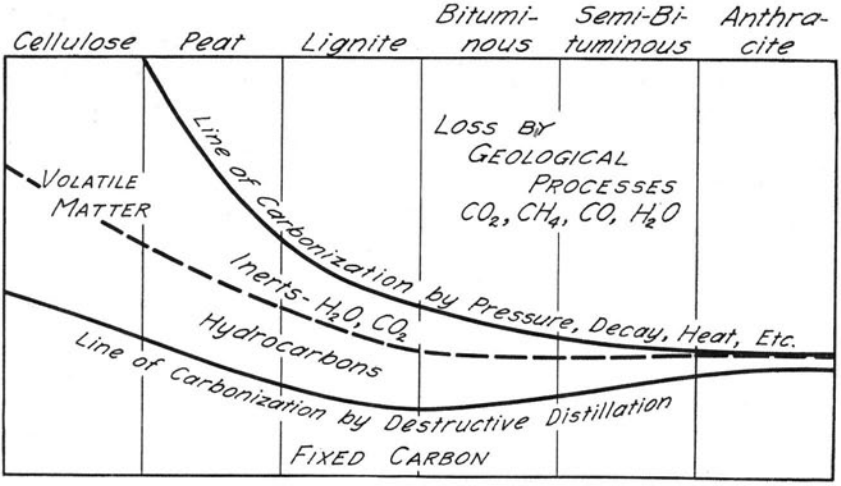

FIG. 1. DECOMPOSITION STAGES OF VEGETAL MATERIAL

these factors there are two that seem to be most important from this point of view. These are the content of *oxygen,* and the percentage of *volatile matter.* The latter is the natural result of geological processes such as decay, pressure, and heat, and the effect of these is well illustrated by a chart (Fig. 1) showing the hypothetical changes which solid fuels have undergone in arriving at their present stage in the cycle of geological transformation.*

In this figure the upper line of geological decomposition by decay, pressure, etc., because of its relation to the lower line of carbonization by destructive distillation, becomes of special significance when an attempt is made to formulate any system of classification which shall be reasonably scientific and at the same time of practical or industrial value.

As a matter of fact, since the loss by pressure and heat largely consists of compounds of oxygen, hydrogen, and carbon, these geological alterations are in effect a method of carbonization, and are clearly related to the lower line showing carbonization by means of destructive distillation wherein only fixed carbon remains. Between these two stages of decomposition is the volatile matter, and obviously it is the deciding factor which governs the character of the residuum left as a result of the geological changes. Not only is the relative quantity of volatile matter of fundamental importance, but the extent

*Adapted from Bulletin No. 3, Illinois State Geological Survey, p. 29, 1906.

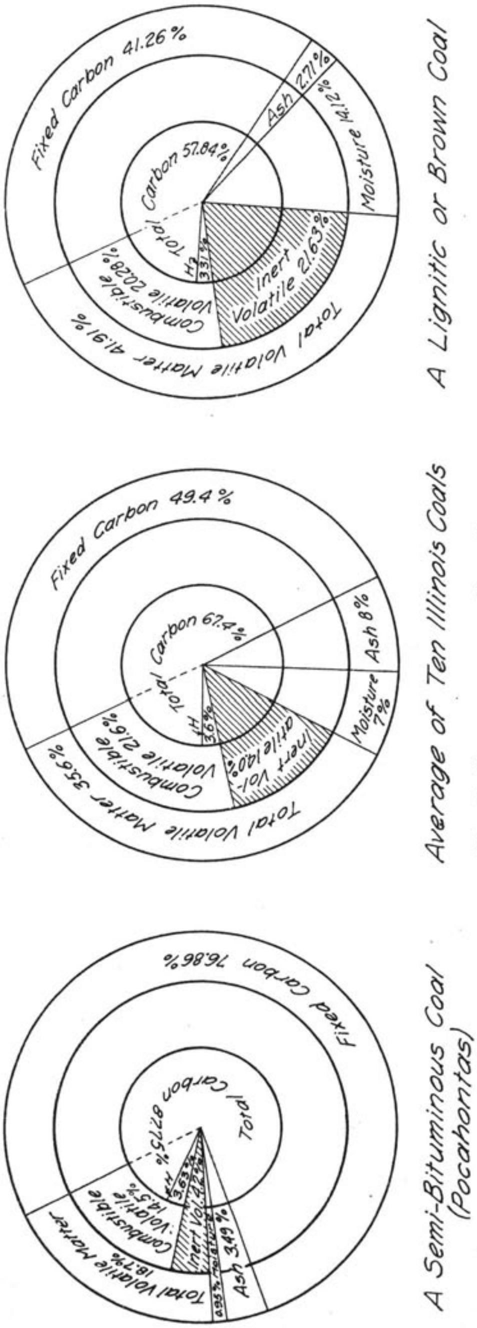

FIG. 2. COMPOSITION OF COAL TYPES

of residual oxygen is also of decided significance in its influence upon the character of the fuel of which it is a part. This feature is still further illustrated by Fig. 2, where three types of coal are presented in diagrammatic form with reference to their composition.

Within the total "volatile matter" for each type a shaded portion is set off which represents the relative amount of oxygen compounds. Since these oxygen compounds already represent a saturated condition so far as heat of oxidation is concerned they are here represented as so much inert material, but the obvious effect from the standpoint of classification is that with higher or lower content of these constituents a decided difference in quality and character of the coal is found. Those fuels with the higher percentage of inert substance are in a less advanced stage of fuel development. They find their place toward the left areas in Fig. 1, and in geological terms are referred to as the younger or more recent coals.

It is evident from the foregoing, therefore, that both volatile matter and oxygen are vitally related to type, and since the presence of oxygen in higher or lower amounts will affect the calorific value, that constituent can most readily be given expression through the medium of the heating value. A converse statement can also be made which still further accentuates the part which the calorific value may be made to play in indicating type. The volatile constituents of fuel are almost entirely made up of combinations of carbon, hydrogen, and oxygen. The more hydrogen there is available, the higher will be the calorific value, and since high oxygen reduces the amount of available hydrogen it is again seen that calorific value may be used as a direct index of type.

To use calorific values for purposes of classification involves certain specific and very fundamental considerations. It can be readily understood in the first place that all extraneous or adventitious matter must be eliminated, so that the indicated calories may be made to relate definitely to the pure coal substance. Only by strict observance of that principle can variations in heat value be interpreted to mean variation in type. That is to say, under proper conditions of reference, namely, to the pure or unit coal substance, the heat value may be made an index of variations in the constitution or type of fuel. An increase of oxygen in the unit coal substance, since it is accompanied by a decrease of either the hydrogen or carbon or both, has a nullifying effect upon the calorific value of the unit coal substance and *vice versa,* so that the interrelation of these elements and their effect upon calorific values when divorced from all extraneous material operates in a manner to accentuate or serve as an index for variations in type.

5. *Unit Coal.*—Unit coal is the pure coal substance considered altogether apart from extraneous or adventitious material which by accident or through natural causes may have become associated with the combustible organic substance of the coal.

It is evident from the methods of procedure used in arriving at analytical values that none of the processes employed will give directly the amount of pure fuel substance present in any given case. This is more evident in the case of ash determinations for coal. The ash as weighed is not an exact measure of the inorganic substance present in the original coal. Such items as the hydration of the shaley constituents, the presence of carbonates, or sulphur, especially in the form of iron pyrites, should be looked upon as impurities and not allowed to enter into those considerations which are supposed to be based specifically upon the pure coal substance. In arriving, therefore, at percentage factors which differentiate the pure coal substance from the non-coal substance, the following formula has been proposed:

$$\text{Non-coal} = M + A + \tfrac{5}{8}\,S + 0.08\,(A - \tfrac{10}{8}\,S)$$

in which M is moisture

A is ash as weighed

S is sulphur

$\tfrac{5}{8}\,S$ restores the Fe_2O_3 as weighed in the ash to FeS_2, as weighed in the coal, 3 oxygens or 48 in the ash having been originally 4 sulphurs or 128 in the coal

$\tfrac{10}{8}\,S$ represents the equivalent of Fe_2O_3 as weighed in the ash, that is, the Fe_2O_3 molecule, 160, is $\tfrac{10}{8}$ of the sulphur present in the coal

$(A - \tfrac{10}{8}\,S)$ is the ash as weighed minus the Fe_2O_3

0.08 is a constant applied to the iron-free ash to restore the water of hydration to the earthy matter less iron pyrites, thus representing the true amount of shaley constituent as weighed in the original coal

Where values are given on the dry basis, the M disappears and the formula becomes:

$$\text{Non-coal} = A + \tfrac{5}{8}S + 0.08\,(A - \tfrac{10}{8}S)$$

Simplifying this equation we have:

$$\text{Non-coal} = 1.08\,A + \tfrac{21}{40}S$$

and in its final form the equation as used becomes:

$$\text{Non-coal} = 1.08\,A + \tfrac{22}{40}S$$

Here the fraction $\frac{21}{40}S$ has been changed slightly to $\frac{22}{40}S$ or $0.55S$, as being in the direction of simplifying the calculation as well as promoting accuracy by compensating for the sulphur not in the pyritic form.

Attention has already been called to the use that may be made of calorific values in coal classification, but with the very fundamental proviso that such values be applied to the pure coal substance. This involves not only the elimination of all mineral and extraneous matter, but the correcting of the values ordinarily obtained in analysis, especially for ash, in such a manner as to make it possible to arrive at the percentage of actual combustible or unit coal substance in the original material.

If the formula for the non-coal substance as given is a correct expression for that material then the pure or unit coal becomes:

$$\text{Unit coal} = 1.00 - (1.08A + \tfrac{22}{40}S)$$

which gives a basis of reference for the utilization of calorific values.

6. *Unit B. t. u.*—From the expression which has been developed in the preceding discussion for unit coal it follows obviously that the calorific value for unit coal, the unit B. t. u., would be represented by the indicated heat value as derived by the calorimeter, divided by the unit coal factor, thus:

$$\text{Unit B. t. u.} = \frac{\text{indicated B. t. u.} - 5000S}{1.00 - (1.08A + \frac{22}{40}S)}$$

The expression 5000 S is used as indicating the resultant of the burning of the sulphur to SO_2 and the iron to Fe_2O_3. A detailed explanation for the factor as thus adopted is given in Appendix A. The propriety of eliminating the heat of the sulphur is obvious from the purpose involved, namely, to arrive at the heat value for the pure coal substance free from all extraneous matter not basically involved in governing the type of organic material which enters into the constitution of the actual coal substance.

The development of the formulas representing the non-coal, the pure or unit coal, and the unit B. t. u. as set forth are, in the main, based on theoretical considerations. The question naturally arises as to their correctness when put into actual use. Can verification of their value be demonstrated by empirical as well as by theoretical processes?

7. *Evidence of Accuracy of Formula.*—Several methods for verification of the formula suggest themselves. Obviously for a sample of

TABLE 1
COMPARISON OF UNIT COAL VALUES ON FLOAT AND SINK DIVISIONS OF SAME SAMPLES

Description		Water	Ash	Sulphur	B.t.u. As Determined on Float and Sink Samples	B.t.u. As Calculated to Unit Coal	Variation from Float Sample Value
1 Illinois Grundy County	Float	0.00	4.57	1.44	13 475	14 217	+45
	Sink	0.00	21.99	5.00	10 735	14 262	
2 Illinois Williamson County	Float	0.00	4.34	1.07	13 970	14 690	−23
	Sink	0.00	18.28	1.37	11 731	14 667	
3 Indiana Vigo County	Float	0.00	4.27	3.08	13 870	14 638	+60
	Natural	0.00	16.84	7.62	11 790	14 698	
4 South Africa	Float	1.63	6.06	1.38	13 703	15 065	+28
	Sink	1.66	18.94	2.28	11 680	15 093	
5 South Africa	Float	2.07	8.88	0.87	12 989	14 779	+20
	Sink	1.82	15.24	1.80	11 847	14 799	
6 South America	Float	5.97	17.24	0.68	10 602	14 127	+35
	Sink	3.59	49.25	2.58	5 922	14 162	
7 Alabama-Pratt Seam Walker County	Float	1.20	4.40	0.85	14 384	15 371	− 1
	Sink	1.00	16.14	0.83	12 467	15 370	
8 Ala. Mary-Lee Seam Jefferson County	Float	1.04	9.78	0.99	13 683	15 576	+44
	Sink	0.92	23.70	1.23	11 246	15 620	
9 West Virginia Bituminous	Float	1.20	3.40	0.60	14 616	15 416	+27
	Sink	1.15	4.96	0.76	14 373	15 443	
10 Kentucky Cannel	Float	0.97	13.40	1.74	13 560	16 205	−26
	Sink	1.20	39.04	2.87	8 908	16 179	
11 Pennsylvania Anthracite	Float	0.86	7.20	0.72	13 795	15 166	+66
	Sink	0.70	16.75	1.07	12 280	15 232	

coal with high ash, or a high ash sample obtained by use of the "sink" and "float" method of separation, the formula would give unfavorable results if the 8 per cent constant as applied to the ash were wrong. If this factor is correct, then, so far as ash variations are concerned, the B. t. u. values for unit coal as calculated should be substantially the same for the same coal, no matter what the ash content. Similarly, the sulphur corrections, when applied to wide variations in sulphur in the same sample, or in samples from the same mine, should not produce a divergence in the thermal values when calculated to the unit basis. A great mass of data has accumulated from which only a limited number of illustrations need be given. However, those selected are typical, and cover widely separated localities and practically all types of coal.

Table 1 is an assembly of results from samples which have been subjected to the "sink" and "float" process. By this procedure each

TABLE 2

COMPARISON OF HEAT VALUES FOR PURE COAL SUBSTANCE AS DERIVED BY THREE METHODS OF CALCULATION

Description		Analytical Values on Dry Coal Basis			Different Methods of Calculating for Pure Coal Values		
		Ash	Sulphur	B.t.u. by Oxygen Bomb Calorimeter	(a) $\frac{\text{B.t.u.}}{1.00 - A}$	(b) $\frac{\text{B.t.u.} - 4050S}{1.00 - (A - S)}$	(c) $\frac{\text{B.t.u.} - 5000S}{1.00 - (1.08A - \frac{22}{40}S)}$
1 Illinois Williamson Co.	Float	4.08	0.99	13 924	14 535	14 644	14 623
	Sink	17.75	1.15	11 766	14 306	14 451	14 608
				Differences in calculated values	229	193	15
2 Illinois Franklin Co.	Float	4.64	0.54	13 765	14 436	14 492	14 512
	Sink	18.00	0.57	11 639	14 194	14 236	14 474
				Differences in calculated values	242	256	38
3 Illinois Perry Co.	Float	4.22	0.86	13 763	14 369	14 464	14 452
	Sink	22.17	1.15	10 922	14 033	14 183	14 413
				Differences in calculated values	336	281	39

sample is divided into two parts with widely different values for the ash and sulphur. Manifestly the calculation of the indicated heat value to the corresponding value for the unit coal substance furnishes a crucial test for the suitability of the factors chosen for correcting the ash with reference to water of hydration and for sulphur.

At least two other methods have been used to a greater or less extent for deriving the pure coal substance. If the results obtained by use of these formulas are compared with those obtained by the one here proposed, the discrepancies resulting in the case of sink and float samples of the same coal afford further confirmation of the value of the new formula. A tabulated selection of a few cases only can be given in this connection, as shown in Table 2.

The derivation of (a), (b), and (c) by the formulas as given in Table 2 may be understood from the following:

The expression B. t. u. is the indicated heat value as obtained directly by means of the calorimeter. A is the ash as weighed, and S is the sulphur in per cent.

The method under (a) is the usual "ash and moisture free" formula as employed by the engineer for determining the heat values for "combustible."

Under (b) is the method employed by Lord and Haas for determining the value of "H," i.e., the heat to be credited to the pure coal substance free from moisture, ash, and sulphur.*

Under (c) the formula is that for "unit coal" as herein presented, and has already been discussed in detail.

Note that the analytical values are on the "dry coal" or moisture-free basis. Hence "W" for water is not introduced into the formulas.

The marked agreement in float and sink values under (c) is additional evidence of the correctness of the new formula as herein developed.

8. *Significance of Volatile Matter.*—The other distinguishing factor, that is, the ratio of the volatile material to the unit fuel, is an equally important factor in determining the type to which a fuel should be assigned. It will be evident at once that the factor for the volatile matter may also be derived by means of the same corrections as are used in developing the unit substance. Since the volatile matter as determined in the ordinary method of proximate analysis includes as a non-coal constituent the water of hydration of the shaley constituents of the ash, and essentially one-half of the total sulphur, these factors may enter into the calculations in deriving the unit volatile

*Trans. Amer. Inst. Min. Eng., Vol. 27, p. 259, 1898; also Lord and Somermeier, "Report on Coal," 4th Geol. Surv., Ohio, 1908, p. 268.

matter of the coal. Hence, the actual or true volatile matter, V, results from the following expressions:

$$V = \text{volatile as determined} - (\text{water of hydration} + \tfrac{1}{2}S)$$
$$\text{Water of hydration} = 0.08\ (\text{ash as weighed} - \tfrac{10}{8}S)$$
$$V = \text{volatile as determined} - 0.08\ (\text{ash as weighed} - \tfrac{10}{8}S) - \tfrac{1}{2}S.$$
$$V = \text{volatile as determined} - (0.08\,A + 0.4\,S)$$

Hence, percentage of V, or unit volatile

$$= \frac{\text{volatile as determined} - (0.08 + 0.4\,S)}{1.00 - (1.08\,A + 0.55\,S)}$$

These expressions are based on "dry coal" values, and their derivation is readily understood from the illustrations given for the development of the formula for unit coal. One item only may call for a word of explanation. The desirability of eliminating the sulphur from the volatile matter is obvious. This is accomplished by subtracting one-half of the total sulphur present in the coal. Warrant for the use of this factor is found in University of Illinois Studies No. 7.* Here are given the values for total and "fixed" sulphur and "volatile sulphur" by difference. For the 150 samples of coal analyzed, especially for deriving these factors, the average percentage of sulphur discharged in the volatile form in the ordinary method for determination of volatile matter and fixed carbon was 51.5 per cent of the total sulphur present in the coal.

9. *Use of Calorific Value and Percentage Votatile Matter as Basis of Classification.*—In order to utilize the two factors thus obtained, namely, the calorific value of the unit fuel, and the percentage of unit volatile matter, a two-dimension chart is employed in which the abscissas give the percentage of unit volatile matter and the ordinates the thermal values of the unit fuel substance, as shown in Fig. 3. The areas shown on the chart, moreover, will not only indicate the limiting boundaries for the several types of solid fuel, but any individual sample will automatically be so located within its group boundary as to show its relation to the group as a whole and to neighboring groups as well. In this manner, as should naturally be expected, there will be found a certain amount of blending of types at the group boundaries; but even so, this is in accord with the fact that the processes of formation have been progressive in character rather than definitive. An advantage even may be thus seen in the fact that the location of an individual type within its group area becomes significant. The chart as presented in Fig. 3 is intended, therefore, to indicate simply the areas for the types of natural solid fuels as here recognized.

*Parr, S. W., The University Studies, Vol. 1, No. 7, 1904, p. 24, and Table IX, pp. 33-40.

For the purpose of locating a coal within the area which will represent its type it will be seen that it is only necessary to make a calculation from the values obtained in an ordinary proximate analysis, including the calorific value and the sulphur content, as already shown.

10. *Representative Analytical Data for Type Samples of Solid Fuels.*—It will be in order now to assemble representative analytical data for the different solid fuels so that the type characteristics of each may be developed. It will be evident at once that of the mass of analytical values now available only a limited number can be used, but an attempt has been made to make representative selections in sufficient number to furnish a good illustration of the various types now generally recognized. The fuels may be divided according to the following types:

Type 1—Anthracite (Table 3)
Type 2—Semi-anthracite (Table 4)
Type 3—Bituminous A (Low volatile or Pocahontas) (Table 5)
Type 4—Bituminous B (Eastern) (Table 6)
Type 5—Bituminous C (Mid-continental) (Table 7)
Type 6—Bituminous D (Sub-bituminous or black lignite) (Table 8)
Type 7—Lignite (Table 9)
Type 8—Peat (Table 10)
Type 9—Cannels (Table 11)

By way of illustration representative samples of solid fuel for each of the types have been assembled with complete analytical data, from which their location in the several group areas has been indicated in Fig. 4. These locations have been derived from analytical values which are shown in Tables 3 to 11, inclusive. In Table 12 the values for unit volatile and unit B. t. u. are the type averages as derived from these tables.

In Fig. 4 the type coals from each group have been located by dots, while the average for each group as listed in Table 12 has been located on the chart by small circles.

In Fig. 5 over 600 coals have been located on the chart from data as derived mainly from United States Bureau of Mines and Geological Survey publications. The values thus taken may be verified by means of the laboratory numbers and the key references reproduced from the published report for this purpose. These locations represent all of the samples given in Tables 15 to 25 inclusive.

Coals of the world outside of the United States are given in Table 26. These coals, 150 in number, have not been charted but

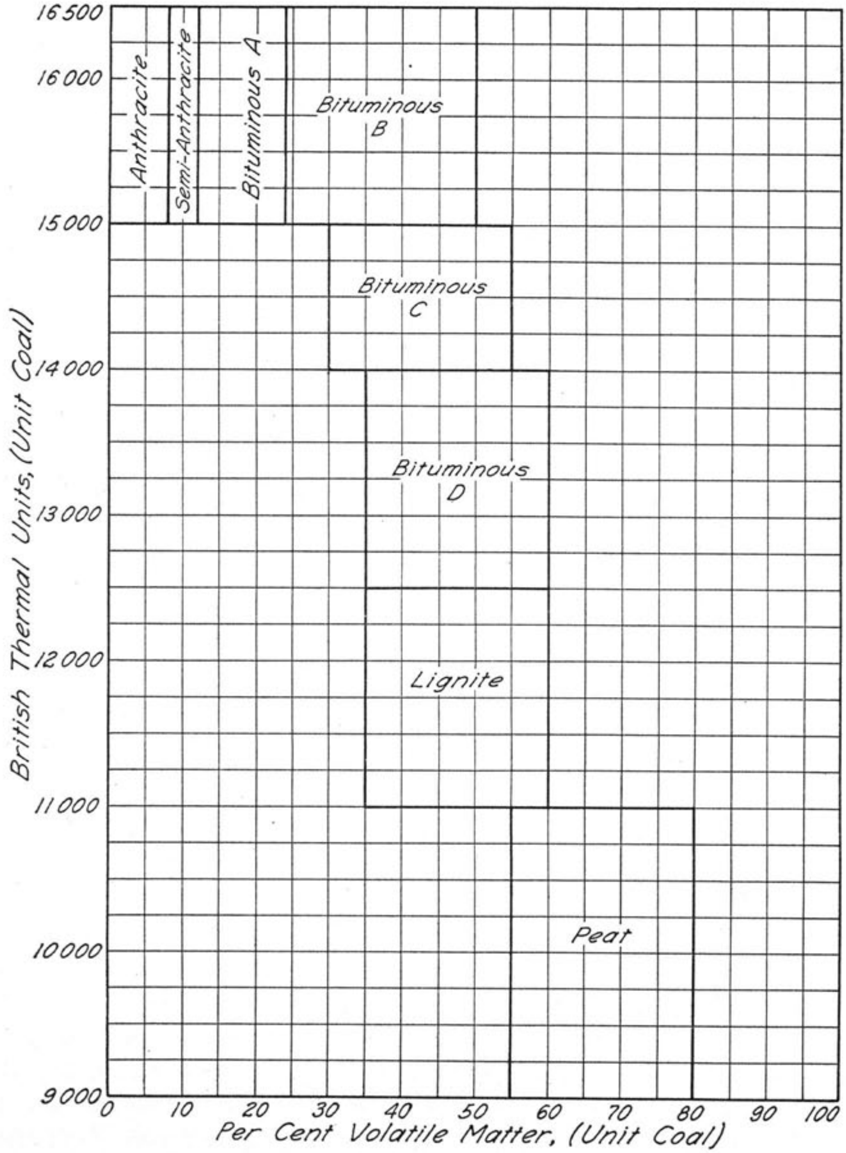

FIG. 3. DEMARKATION OF TYPE AREAS AS DETERMINED BY HEAT VALUES AND VOLATILE MATTER FOR UNIT COMPONENTS

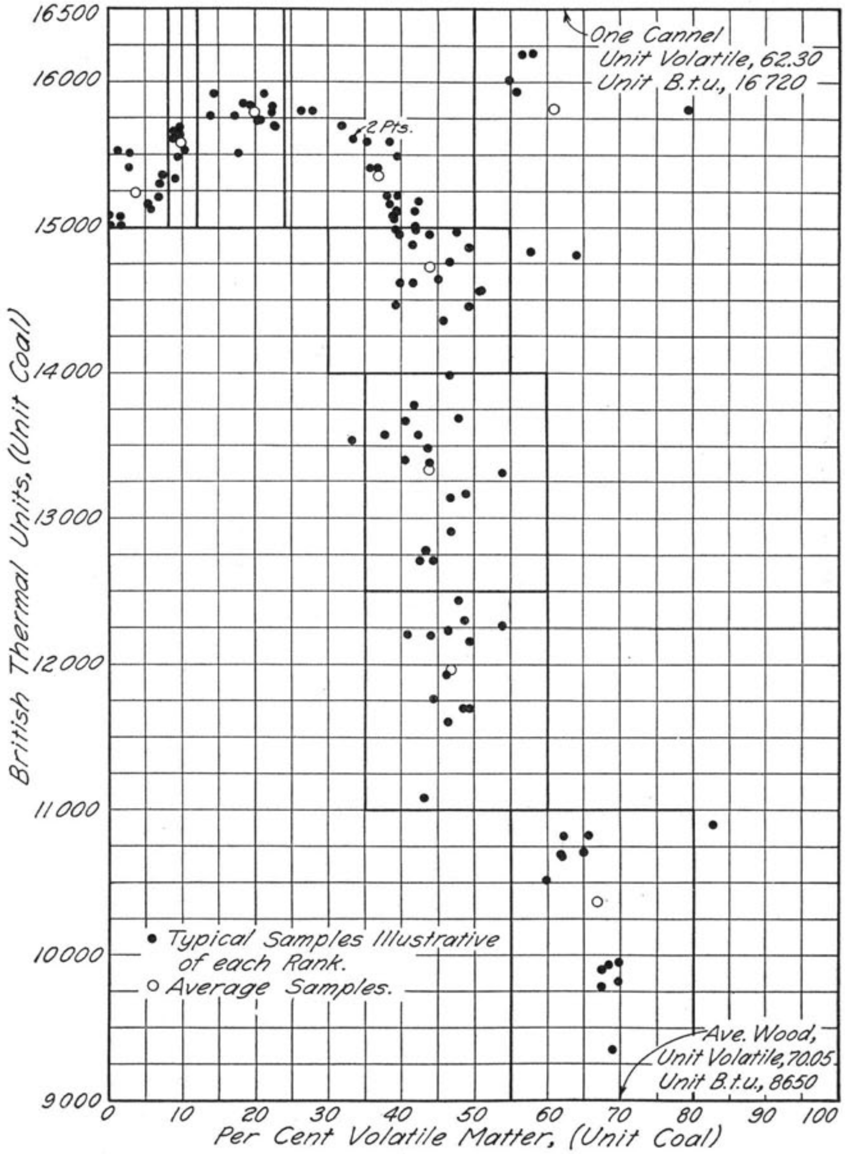

FIG. 4. LOCATION OF TYPE SAMPLES OF AMERICAN COALS

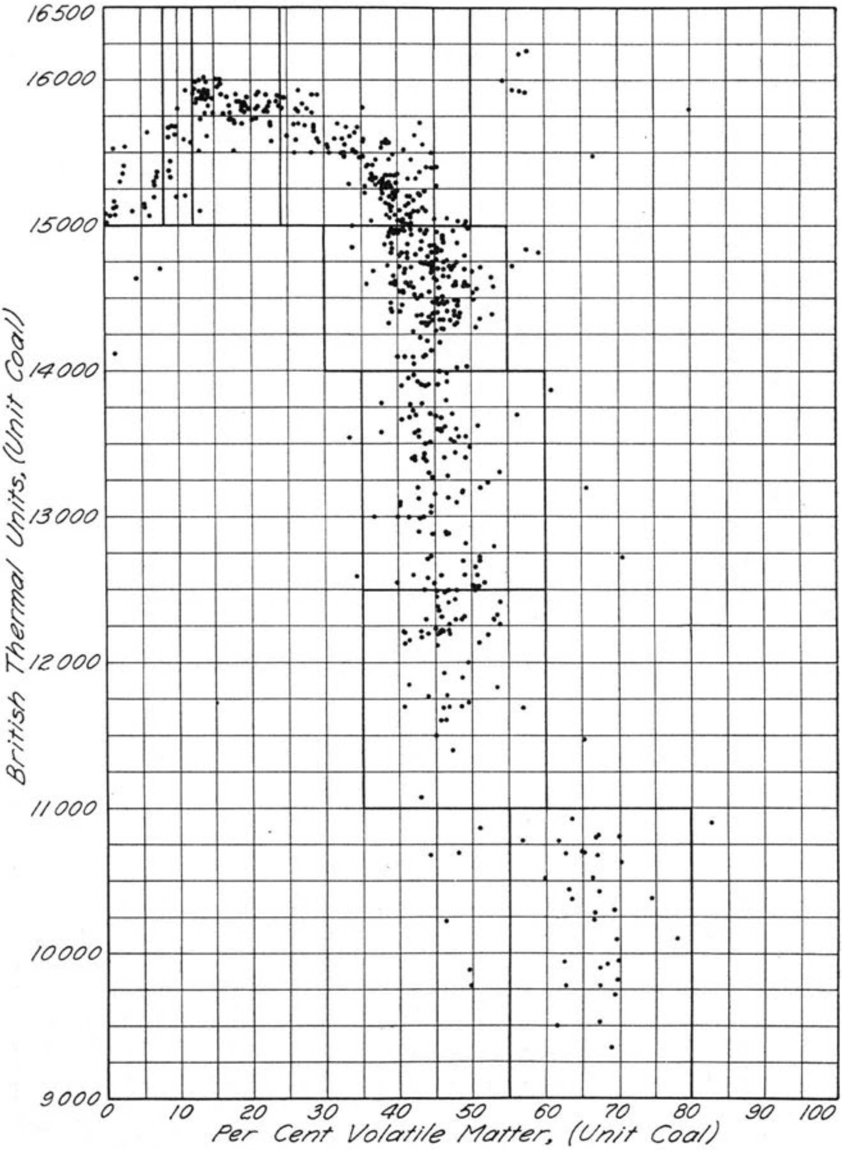

FIG. 5. CLASSIFICATION OF 625 COALS FROM ALL PARTS OF THE UNITED STATES

their class designations, resulting from application of the analytical data, are given in the last column of the table.

IV. Parr System of Coal Classification

11. *Comparison of Systems of Classification.*—The close relationship of the several types thus indicated and the divisions resulting from other methods of classification will readily be seen by comparison with related methods.

Seyler* uses the terms (1) anthracite, (2) carbonaceous, (3) hydrocarbonaceous or bituminous, (a) meta-bituminous, (b) ortho-bituminous, (c) para-bituminous, (4) carbo-hydratous, or lignitous.

These divisions are based upon the limits for carbon, hydrogen, oxygen plus nitrogen, and volatile matter. It will be seen that these subdivisions as named by Seyler are in close agreement with the classification here followed if, as has been done by Seyler, a chart is superimposed delimiting the boundaries for the carbon, hydrogen, and oxygen values for the various groups upon the areas as defined by the calorific values and the factor for the unit volatile matter. In this way the designation of the various groups, which, as already indicated, closely correspond to each other, can be listed in such a way as to show the agreement between the various types as shown in Table 13.

Unfortunately, as will be obvious from a comparison of the terms used for the various groups as thus listed, the proposals for giving names to type substances are widely at variance. The listing, therefore, of the typical solid fuels which is here used must be looked upon as more or less provisional, pending such time as the various students of coal classification are able to agree upon the terms used and establish a permanent nomenclature.

Reference should be made, however, to the use in the list of natural fuels and in the chart, Fig. 4, of the terms used for the subdivisions of bituminous coals; namely, A, B, C, and D. The argument in favor of the use of these terms over existing designations may be stated as follows:

The sub-division of bituminous coal into the groups A, B, C, and D is consistent with the relative ranks in the order of designation as thus indicated. That is to say, Bituminous A, or the low volatile,

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*Seyler, Clarence A., "The Chemical Classification of Coal," Fuel in Science and Practice, Vol. 2, p. 272-273.
Ibid., Vol. 3, pages 15-26, 1924.
Ibid., Vol. 3, pages 41-49.
Ibid., Vol. 3, pages 79-83.

coals would normally be given the highest rank, and the designation of Bituminous D, or the sub-bituminous, coals would be thus rated according to their ranks in the general bituminous family. In this manner the term "semi-bituminous" for coals of the low volatile or Pocahontas type is avoided. The term "semi-bituminous," it is universally agreed, is unfortunate and inconsistent. Seyler's term of "carbonaceous" for this division is equally objectionable. The terms used by him, ortho-, para-, and meta-, while acceptable to the student of coal constitution, are not so readily interpreted by the layman as the letters B, C, and D. As already indicated, however, these subdivisional terms in the bituminous family are not at the present time universally agreed upon.

As has already been pointed out, the position of each coal within the proper area indicates the relation it bears to the other members of its own rank, and also the approximation in the matter of constitution to the composition of the coals of neighboring areas.

In each class of the true bituminous coals, A, B, and C, there may occur subdivisions, such as long or short flame, caking and non-caking, or splint coals, but no attempt at these ultimate subdivisions is made here. These characteristics are in evidence upon use, do not seem to follow any definitely marked variation in composition, and are consequently not susceptible of classification along distinctly chemical lines.

The lignites, or Type 7, as well as the peats, Type 8, group themselves into distinctive areas even more definitely than fuels of the higher ranks. Wood, or Type 10, is equally distinctive and falls entirely outside of or below the chart; that is, it has a lower calorific value than the 9000 B.t.u. line of the chart.

The cannel coals, or Type 9, are highly resinous because of the predominance of spore bodies in their composition, a condition which is at once in evidence as accounting for the high heat value and high percentage of volatile matter in their unit constituents.

12. *Parr System of Classification.*—The formula for arriving at the unit coal substance was first proposed in 1908 and published as Bulletin No. 37 of the Engineering Experiment Station in 1909. In the descriptive matter of that bulletin the method of arriving at the unit coal formula was given in detail, and the heat values for unit coal were calculated for all of the samples for which analytical data were available, at that time numbering approximately 350 samples. These samples covered a wide area, and the results included analytical data from the Ohio State Geological Survey and the U. S. Geological Sur-

vey, in addition to those accumulated in the laboratories of the Station. Subsequent studies and practical utilization of the formula have emphasized the value of the unit factor thus obtained, especially in the study of alterations in the coal substance as a result of weathering and oxidizing conditions. In studies made by Vliet in 1917* a number of curves were tested out to determine if any available factors other than volatile matter and B.t.u. could be used to advantage as the basis of a system of classification. In that study use was made of the percentage of oxygen and total carbon, the percentage of volatile matter, the percentage of oxygen, and the percentage of volatile matter and total carbon. It was found that all the combinations could be used to good advantage as far as results were concerned. None of the combinations seemed to give better results than the one here suggested. After the value of the formula has been tested out in a practical way, in work done by the Station and by others, the advantages to be derived from its use have become more and more apparent. At the present date, however, the editions of the earlier publications giving the derivation and application of the formula have become exhausted.

It seemed desirable, therefore, in the present bulletin to give again the derivation and application of the formula on which the Parr system of coal classification is based, as well as to set forth the evidences of its value, and to present again some of the reasons for adopting it in its present form.

In the following tables the coals of the United States, and also those of the rest of the world are arranged according to the Parr system of classification. Since a very much wider range of analytical values is available at the present time than formerly, these have been embodied in the tables, which offer an opportunity for the further testing out of the applicability of the formula, as proposed, as a basis of classification.

*Vliet, E. B., "The Classification of Coal," Thesis for Degree of Master of Science in Chemistry, Univ. of Ill.

PARR CLASSIFICATION OF COAL

Key References { Letter indicates the reference; Numeral indicates the page }

a =	Bulletin No. 85, U. S. Bur. of Mines
b =	" " 22, "
c =	" " 123, "
d =	" " 621, U. S. Geol. Survey
e =	" " 16, U. S. Bur. of Mines
f =	" " 193, "
g =	" " 119, "
h =	" " 339, U. S. Geol. Survey
i =	" " 29, Ill. State Geol. Survey
j =	Coal Catalogue (1926)
k =	Coal Resources of the World (1913)
l =	Report No. 14 Sci. & Ind. Research Council of Alberta. (1925)
m =	Fuel in Science & Practice 2 (1923)
n =	Coal and Its Scientific Uses, Bone. (1919)
o =	Brennstoff und Verbrennungsvorgang, Authäuser (1921)

TABLE 3
SOLID FUELS—TYPE 1, ANTHRACITE

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Colorado	Gunnison		2.70	3.32	88.15	5.83	0.80	14 099	7833	15 510	2.79
Colorado	Gunnison		4.86	6.96	81.87	6.31	0.81	13 468	7475	15 300	6.98
New Mexico	Santa Fe		5.70	2.18	86.13	5.93	0.69	13 286	7375	15 130	1.63
Pennsylvania	Schuylkill		2.76	2.48	82.07	12.69	0.54	12 577	6970	15 075	1.51
Pennsylvania	Schuylkill		2.80	1.16	88.21	7.83	0.89	13 298	7380	15 010	0.24
Pennsylvania	Schuylkill		2.30	1.54	82.77	13.39	1.05	12 523	6955	15 080	0.08
Pennsylvania	Schuylkill		3.33	3.27	84.28	9.12	0.60	13 351	7415	15 410	2.66
Pennsylvania	Luzerne		1.31	5.68	85.87	7.14	0.42	13 777	7645	15 150	5.44
Pennsylvania	Luzerne		2.19	5.67	86.24	5.90	0.57	13 828	7680	15 120	5.77
Pennsylvania	Lackawanna		3.43	6.79	78.25	11.53	0.46	12 782	7097	15 200	6.75
Washington	Lewis	Primrose	7.40	5.00	51.80	35.80	0.75	8 200	4555	15 530	1.20
Washington	Whatcom	Puget	4.40	7.40	76.00	12.23	0.96	12 590	6998	15 360	7.37
		Average	3.59	4.29	80.97	11.14	0.71	12 815	7115	15 239	3.53

TABLE 4

SOLID FUELS—TYPE 2, SEMI-ANTHRACITE

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Arkansas	Pope	Harts-horne	2.07	9.81	78.82	9.30	1.74	13 702	7620	15 690	9.65
Colorado	Gunnison	Crested Butte	1.94	9.22	80.34	8.50	0.85	13 740	7640	15 485	9.28
Pennsylvania	Sullivan		3.38	8.47	76.65	11.50	0.63	13 156	7305	15 660	8.71
Pennsylvania	Sullivan		3.47	9.28	76.10	11.15	0.78	13 216	7345	15 685	9.60
Pennsylvania	Sullivan		3.40	9.34	75.58	11.68	0.81	13 120	7292	15 630	9.67
Pennsylvania	Sullivan		3.16	8.59	78.08	10.17	0.67	13 376	7430	15 610	8.58
Utah	Washington	No. 4	7.02	10.30	60.61	22.07	4.06	10 408	5787	15 290	10.35
Virginia	Montgomery	Large	2.52	12.38	67.50	17.60	0.51	12 360	6860	15 770	13.81
Washington	Lewis	Primrose	3.60	8.40	59.60	28.40	0.66	10 050	5578	15 330	9.00
		Average	3.39	9.53	72.58	14.48	1.19	12 570	6980	15 580	9.83

TABLE 5
SOLID FUELS—TYPE 3, BITUMINOUS A
Low Volatile

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Arkansas	Sebastian	Harts-horne	1.7	16.91	73.03	8.36	1.23	13 840	7688	15 510	17.70
Maryland	Allegheny	Pitts-burgh	2.43	19.02	71.19	7.36	1.04	14 087	7822	15 730	20.12
Maryland	Garrett	Freeport	2.39	16.41	71.82	9.38	2.01	13 707	7618	15 770	17.23
Oklahoma	Haskell	Harts-horne	2.37	19.26	69.54	8.83	1.03	13 840	7690	15 740	20.72
Pennsylvania	Cambria	Lower Freeport	2.87	21.44	69.23	6.46	1.52	14 177	7875	15 690	22.74
Pennsylvania	Clearfield	Lower Kittan-ning	3.20	21.00	69.30	6.50	0.69	14 060	7820	15 700	22.60
Pennsylvania	Somerset	Pitts-burgh	3.04	19.59	70.33	7.04	0.74	14 175	8045	15 920	21.10
Pennsylvania	Huntingdon	Fulton	1.65	17.48	72.26	8.61	1.55	14 076	7825	15 850	18.31
Virginia	Tazewell	Pocahon-tas No. 3	2.85	21.25	71.43	4.47	0.59	14 620	8128	15 830	22.40
W. Virginia	Fayette	Sewell	3.58	21.07	72.75	2.60	0.64	14 751	8190	15 790	22.20
W. Virginia	McDowell	Pocahon-tas No. 4	2.87	14.91	78.39	3.83	0.81	14 809	8235	15 920	14.33
W. Virginia	McDowell	Pocahon-tas No. 3	2.03	18.51	75.54	3.92	0.49	14 812	8240	15 840	19.29
		Average	2.58	18.90	72.06	6.45	1.02	14 246	7915	15 795	19.87

TABLE 6

SOLID FUELS—TYPE 4, BITUMINOUS B

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Alabama	St. Clair	Harkness	2.28	33.07	54.63	10.02	1.76	13 333	7405	15 410	36.77
Alabama	Tuscaloosa	Jagger	1.60	24.98	68.55	4.87	0.51	14 697	8155	15 800	26.28
Alabama	Jefferson	Pratt	1.05	31.70	62.15	6.15	1.38	14 377	7980	15 610	33.45
Kentucky	Letcher	Elkhorn	2.91	36.33	57.53	3.23	0.53	14 170	7875	15 160	38.44
Kentucky	Harlan	Harlan	2.80	37.00	55.90	4.30	1.10	13 950	7748	15 120	39.42
Kentucky	Whitley	Jellico	5.02	36.08	54.47	4.43	0.92	13 608	7555	15 110	39.40
Ohio	Jefferson	Lower Freeport	3.50	37.98	51.08	7.44	3.09	13 286	7377	15 140	41.78
Ohio	Noble	No. 7	5.15	37.34	49.00	8.51	2.94	12 733	7074	15 180	42.30
Ohio	Jefferson	No. 8	4.11	37.96	50.23	7.70	3.84	13 014	7230	15 010	41.90
Ohio	Guernsey	Upper Freeport	6.00	34.20	52.00	7.83	1.98	12 720	7065	15 080	38.80
Pennsylvania	Washington	Washington	4.45	33.53	49.51	12.51	3.04	12 242	6800	15 060	39.00
Pennsylvania	Westmoreland	Pittsburgh	2.73	30.34	57.80	9.13	1.33	13 613	7556	15 610	33.47
Pennsylvania	Cambria	Upper Freeport	2.73	26.04	65.05	6.18	1.39	14 269	7925	15 800	27.82
Pennsylvania	Jefferson	Lower Freeport	1.86	34.63	53.23	10.28	2.91	13 151	7300	15 220	38.00
Virginia	Russell	Upper Banner	2.07	35.90	57.70	5.33	0.57	14 335	7952	15 590	38.40
Virginia	Wise	Imboden	2.16	33.10	58.27	6.47	0.68	13 994	7756	15 410	35.70
W. Virginia	Marion	Pittsburgh	1.75	36.77	55.14	6.34	0.90	14 107	7845	15 490	39.50
W. Virginia	Randolph	Lower Kittanning	1.45	28.97	59.48	10.10	0.98	13 718	7620	15 700	31.84
W. Virginia	Kanawha	Coalburg	3.44	35.20	53.08	8.28	0.70	13 304	7396	15 220	39.50
W. Virginia	Kanawha	No. 2 Gas	2.66	33.30	59.60	4.44	1.14	14 368	7975	15 590	35.38
		Average	2.98	33.72	56.22	7.17	1.58	13 650	7580	15 365	36.85

TABLE 7
SOLID FUELS—TYPE 5, BITUMINOUS C

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Illinois	Vermilion	No. 7	13.16	37.95	39.02	9.85	4.33	11 110	6175	14 760	46.60
Illinois	Williamson	No. 6	9.44	32.99	48.95	8.62	0.93	11 858	6594	14 470	39.10
Illinois	Saline	No. 5	5.56	34.41	51.31	8.72	2.87	12 643	7038	14 990	39.04
Illinois	Sangamon	No. 5	13.09	36.51	41.14	9.26	3.77	10 935	6075	14 360	45.70
Illinois	Bureau	No. 2	16.27	38.35	38.00	7.38	2.93	10 883	6045	14 480	49.25
Illinois	Mercer	No. 1	15.58	39.17	35.80	9.45	4.69	10 673	5927	14 570	50.98
Indiana	Sullivan	No. 6	14.86	31.65	46.14	7.35	2.16	11 324	6300	14 620	39.78
Indiana	Vigo	Minshall	13.10	36.83	41.73	8.34	2.60	11 484	6378	14 860	49.20
Iowa	Lucas		15.39	30.49	41.49	12.63	3.19	10 242	5690	14 560	40.70
Iowa	Marion		14.21	33.17	37.40	15.22	4.66	10 019	5573	14 640	45.00
Kentucky	Webster	No. 12	5.58	35.04	51.32	8.06	1.59	12 755	7095	14 950	39.68
Kentucky	Hopkins	No. 14	8.85	35.29	47.51	8.35	2.79	11 921	6625	14 595	41.51
Kentucky	Union	No. 9	4.37	36.27	47.67	11.69	3.58	12 325	6852	14 985	41.80
Kansas	Osage	Osage	5.10	36.85	48.10	9.95	5.02	10 930	6070	14 970	47.58
Missouri	Henry	Jordan	10.10	34.83	41.76	13.31	4.32	11 158	6200	14 950	43.78
Oklahoma	Okmulgee	Henryetta	8.87	34.82	47.68	8.63	1.62	12 096	6720	14 880	41.45
		Average	10.85	35.29	44.06	9.80	3.09	11 397	6335	14 727	43.82

TABLE 8
SOLID FUELS—TYPE 6, BITUMINOUS D
(Sub-Bituminous)

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Colorado	Boulder		19.14	33.44	42.07	5.35	0.27	10 017	5570	13 380	43.90
Colorado	El Paso		19.23	32.34	41.41	7.02	0.45	9 306	5170	12 780	43.43
Colorado	Moffat		22.10	31.61	41.95	4.34	0.72	9 297	5165	12 710	42.50
Colorado	Weld		22.20	39.23	33.12	5.45	0.33	9 578	5320	13 310	53.90
Montana	Chouteau		16.83	27.89	43.78	11.50	1.19	9 563	5315	13 575	37.69
Montana	Musselshell	Home-stead	18.14	27.22	50.49	4.15	0.88	10 420	5795	13 540	33.20
Montana	Park	Maxey	16.33	30.12	40.05	13.50	0.41	9 247	5130	13 400	40.51
New Mexico	McKinley		13.50	37.75	42.51	6.24	0.36	11 140	6195	13 990	46.65
New Mexico	San Juan		19.01	32.43	43.15	5.41	0.92	10 193	5670	13 575	42.30
Utah	Summit		17.08	36.94	41.24	4.74	1.53	10 179	5663	13 140	46.72
Washington	King	No. 1	16.45	34.63	36.38	12.54	0.38	9 581	5335	13 690	47.96
Washington	Lewis		20.50	33.50	33.70	12.31	1.28	8 690	4820	13 170	48.80
Washington	Thurston		21.00	33.10	36.70	9.20	0.42	8 910	4950	12 910	46.78
Wyoming	Carbon		13.62	34.55	43.14	8.69	1.44	10 339	5745	13 480	43.60
Wyoming	Hot Springs	Gebo	17.87	31.26	43.48	7.39	0.66	10 062	5594	13 780	41.75
Wyoming	Sheridan		22.57	32.53	40.36	4.55	0.30	9 218	5123	12 710	44.34
Wyoming	Sweetwater		15.71	33.50	48.40	2.39	0.93	11 144	6185	13 670	40.55
		Average	18.31	33.06	41.29	7.34	0.73	9 818	5450	13 330	43.80

TABLE 9

SOLID FUELS—TYPE 7, LIGNITE

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Colorado	Adams	Laramie	35.00	27.39	30.23	7.38	0.31	6 982	3880	12 230	46.90
Colorado	Elbert		33.10	25.60	25.60	15.66	0.44	6 150	3420	12 300	48.60
Colorado	El Paso		34.40	24.44	27.27	13.89	0.14	6 055	3362	11 930	46.20
Montana	Valley		42.81	25.72	26.83	4.64	0.24	6 105	3392	11 700	48.50
Montana	Custer		29.13	25.33	30.51	15.03	0.55	6 662	3701	12 200	44.00
North Dakota	Billings		43.51	25.23	24.87	6.39	1.04	5 814	3230	11 700	49.40
North Dakota	Bowman		34.80	31.09	25.98	8.13	0.66	6 916	3840	12 270	53.80
North Dakota	Morton		33.12	25.53	36.05	5.30	0.69	7 466	4148	12 210	40.80
North Dakota	Stark		42.06	24.55	25.73	7.66	1.13	6 158	3420	12 440	47.80
North Dakota	Ward		36.93	24.92	27.72	10.43	0.22	6 010	3340	11 610	46.40
North Dakota	Williams		42.91	26.81	24.98	5.30	0.71	6 232	3460	12 160	49.30
Wyoming	Carbon		18.41	34.50	43.38	3.71	0.28	9 130	5027	11 770	44.40
Wyoming	Sweetwater		23.30	31.94	41.49	3.27	0.53	8 100	4500	11 080	43.10
		Average	34.57	27.16	30.05	8.21	0.53	6 752	3747	11 970	46.86

TABLE 10
SOLID FUELS—TYPE 8, PEAT

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Connecticut	Fairfield		90.31	3.79	1.27	4.63	0.08	511	284	10 900	82.68
Connecticut	New London		85.66	8.52	4.54	1.28	0.10	1382	769	9 900	67.40
Florida	Duval		73.10	14.00	8.05	4.85	1.06	2309	1282	10 695	61.80
Florida	Lake		82.12	11.75	5.72	0.41	0.05	1886	1047	10 820	67.20
Florida	Putnam		80.78	9.72	6.32	3.18	0.40	1661	924	10 520	59.80
Maine	Aroostook		86.18	8.27	3.98	1.57	0.10	1294	719	10 680	67.00
Maine	Knox		90.82	6.07	2.73	0.38	0.02	819	455	9 350	68.80
Maine	Washington		85.22	8.86	4.72	1.20	0.07	1444	802	10 710	64.90
Michigan	Kalamazoo		66.91	19.04	9.29	4.76	0.09	3024	1670	10 825	66.66
New York	Oswego		54.66	29.15	12.44	3.75	0.17	4104	2278	9 950	69.77
Wisconsin	Dane		71.33	16.01	6.75	5.91	0.12	2187	1216	9 820	69.61
Wisconsin	Langlade		80.24	9.21	4.17	6.38	0.13	1256	697	9 780	67.40
Wisconsin	Marinette		76.36	10.78	4.66	8.20	0.16	1498	832	9 930	68.30
		Average	78.74	11.93	5.74	3.57	0.19	1798	999	10 370	66.80

TABLE 11
SOLID FUELS—TYPE 9, CANNELS

State	County	Seam	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Calories	Unit B.t.u.	Unit Volatile
Indiana	Perry		1.47	49.08	26.35	23.10	1.50	10 850	6030	14 810	64.0
Kentucky	Johnson	Cannel	2.36	48.40	38.75	10.49	1.20	13 770	7645	16 010	54.9
Kentucky	Johnson	Lesley Cannel	1.70	50.76	38.23	9.31	1.02	14 250	7915	16 190	56.5
Tennessee	Campbell	Blue Gem	1.50	45.06	34.13	19.31	1.16	12 340	6855	15 930	55.8
Texas	Webb	Cannel	3.98	48.87	34.91	12.24	1.96	12 227	6790	14 830	57.65
Washington	Lewis	Cannel No. 3	7.88	61.57	15.11	15.44	0.29	11 920	6630	15 810	79.26
W. Virginia	Boone	Chilton	0.52	50.92	35.82	12.74	1.10	13 830	7680	16 200	57.95
W. Virginia	Boone	Cedar Grove	0.43	56.99	33.90	8.68	1.85	15 000	8335	16 720	62.30
		Average	2.48	51.45	32.14	13.91	1.26	13 023	7230	15 820	60.85

TABLE 12
AVERAGE OF TYPE SAMPLES TAKEN FROM TABLES 3 TO 11
Using Values for Unit Volatile and Unit B.t.u.

	Unit B.t.u.	Unit Volatile
Type 1—Anthracite	15 239	3.53
Type 2—Semi-anthracite	15 580	9.83
Type 3—Bituminous A	15 795	19.87
Type 4—Bituminous B	15 365	36.85
Type 5—Bituminous C	14 727	43.82
Type 6—Bituminous D	13 330	43.80
Type 7—Lignite	11 970	46.86
Type 8—Peat	10 370	66.80
Type 9—Cannels	15 820	60.85

TABLE 13
COMPARATIVE CLASSIFICATION OF SOLID FUELS

Earlier Classification as Developed in the U. S.	Classification by Seyler	Present Proposed Classification
1. Anthracite	1. Anthracite	1. Anthracite
2. Semi-anthracites	2. Carbonaceous	2. Semi-anthracites
3. Semi-bituminous or low volatile	3. Meta-bituminous (Short flame)	3. Bituminous A
4. Bituminous (Eastern field)	4. Ortho-bituminous (True bituminous)	4. Bituminous B
5. Bituminous (Mid-continental field)	5. Para-bituminous (Low flame)	5. Bituminous C
6. Lignite, black, or sub-bituminous	6. Lignitous	6. Bituminous D
7. Lignite, brown	7. Lignitous	7. Lignite
		8. Peat
		9. Cannels
		10. Wood

TABLE 14
CLASS LIMITS IN PARR SYSTEM OF COAL CLASSIFICATION

Type	Unit Volatile Per cent		Unit B.t.u.	
	Low	High	Low	High
Anthracite	0	8	15 000	16 500
Semi-anthracite	8	12	15 000	16 500
Bituminous A	12	24	15 000	16 500
Bituminous B	24	50	15 000	16 500
Bituminous C	30	55	14 000	15 000
Bituminous D	35	60	12 500	14 000
Lignite	35	60	11 000	12 500
Peat	55	80	9 000	11 000
Cannel	50	80	15 000	16 500
Sub-cannel	55	80	14 000	15 000
Strays	Not in above classes			

TABLE 15

ANTHRACITE COALS OF THE UNITED STATES

Unit Volatile 0 to 8 per cent
Unit B.t.u. 15 000 to 16 500

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Colo.	Gunnison	Anth.	7 979	63b	2.80	15 540
	"	"	8 246	"	6.98	15 280
	Huerfano	Natural Coke	6 535	65b	6.27	15 070
N. Mex.	Santa Fe	Anth.	6 153	141b	1.63	15 130
Penn.	Schuylkill	"	5 956	171b	1.50	15 080
	"	"	5 954	172b	0.24	15 010
	"	"	5 955	"	0.08	15 080
	"	"	5 953	"	2.66	15 410
	Luzerne	"	11 441	93a	5.50	15 120
	"	"	11 782	"	5.45	15 150
	Lackawana	"	11 440	"	6.75	15 200
	(Average analysis of Pennsylvania anthracite delivered to Government buildings in Washington during winter 1906-07)		Furnace	24h	1.42	15 120
			Egg	"	2.12	15 290
			Pea	"	1.71	15 130
			Buckwheat	"	0.87	15 070
			Furnace	"	1.40	15 160
			Egg	25h	2.50	15 360
Va.	Montgomery	Semi-anth.	5 938	197b	5.97	15 630
Wash.	Whatcom	Anth.	19 722	369d	7.36	15 330
	"	"	19 723	"	6.85	15 300
	Lewis	Bit.	6 494	215b	3.81	15 100
	"	Anth.	9 090	216b	1.20	15 530
	Whatcom	"	....	835j	7.37	15 360

TABLE 16

SEMI-ANTHRACITE COALS OF THE UNITED STATES

Unit Volatile 8 to 12 per cent
Unit B.t.u. 15 000 to 16 500

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Ark.	Pope	Semi-anth.	18 755	29c	12.00	15 570
	Johnson	"	3 369	48b	10.00	15 800
	Pope	"	3 176	49b	9.64	15 690
Colo.	Huerfano	Bit.	13 528	26a	11.08	15 200
Penn.	Sullivan	Semi-anth.	9 665	180b	8.70	15 670
	"	"	9 655	"	8.74	15 610
	"	"	9 652	"	9.67	15 630
	"	"	9 656	"	9.60	15 685
Utah	Washington	....	....	792j	10.35	15 290
Wash.	Lewis	Semi-anth.	9 092	216b	8.72	15 320
	"	"	12 565	108a	9.92	15 200
	"	"	....	839j	9.00	15 330
	Pierce	"	9 577	220b	10.68	15 570
	Whatcom	"	19 725	369d	9.20	15 680

Table 17
Bituminous A Coals of the United States
Unit Volatile 12 to 24 per cent
Unit B.t.u. 15 000 to 16 500

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Ark.	Sebastian	Semi-bit.	18 062	30c	17.50	15 730
	"	Semi-anth.	W69 379	22f	17.70	15 510
	Logan	Semi-bit.	18 753	29c	17.80	15 700
	Johnson	"	1 331	48b	13.10	15 730
	Franklin	Bit.	69 644	22f	14.00	15 620
Colo.	Pitkin	Semi-bit.	4 047	75b	23.00	16 000
Ga.	Walker	"	121	17g	20.70	15 800
	"	"	122	"	22.30	15 780
Md.	Garrett	"	17 653	56c	16.78	15 770
	"	"	26 514	44f	17.23	15 770
	Allegheny	"	20 336	55c	22.10	15 780
	"	"	26 506	41c	20.12	15 730
Okla.	Haskell	Bit.	10 057	149b	20.72	15 740
	"	"	13 693	64a	22.70	15 580
	LeFlore	Semi-bit.	19 678	67c	17.60	15 730
Pa.	Cambria	"	12 213	77a	15.04	15 820
	"	"	14 243	74a	18.96	15 790
	"	"	12 375	84a	21.20	15 820
	"	"	13 640	73a	22.20	15 900
	"	Bit.	12 221	69a	22.80	15 850
	"	Semi-bit.	12 372	"	23.80	15 890
	"	Bit.	12 165	70a	23.80	15 820
	"	"	12 370	73a	24.20	15 880
	"	Semi-bit.	9 028	164b	12.50	15 990
	"	"	9 031	"	13.00	15 920
	"	"	9 029	165b	12.34	15 940
	"	"	10 292	156b	22.74	15 690
	Somerset	"	12 218	97a	16.60	15 880
	"	"	12 209	94a	16.30	15 900
	"	"	12 214	"	19.80	15 880
	"	"	9 020	175b	14.20	15 900
	"	"	9 022	176b	13.63	16 020
	"	"	8 940	177b	12.48	15 840
	"	"	6 304	172b	21.10	15 920
	Huntingdon	"	12 120	90a	16.10	15 970
	"	"	10 333	169b	18.31	15 850
	Bedford	"	15 060	69a	17.03	15 800
	Clearfield	Bit.	12 047	86a	23.40	15 850
	"	Semi-bit.	8 489	167b	22.60	15 700
	Fulton	"	10 333	169b	18.31	15 850
Va.	Pulaski	"	19 431F	325d	12.96	15 510
	Montgomery	"	19 357	324d	13.80	15 770
	Tazewell	"	8 750	199b	15.22	16 000
	"	....	....	811j	22.40	15 830
Wash.	Louis	Sub-bit.	9 091	216b	13.00	15 080
W. Va.	Mercer	Semi-bit.	14 234	123a	18.30	15 900
	"	"	8 461	275b	13.60	15 870
	"	"	8 473	279b	12.72	15 870
	McDowell	"	24 801	123c	18.90	15 700
	"	"	14 157	114a	19.10	15 780
	"	"	8 321	248b	14.30	15 880
	"	"	8 418	249b	13.42	15 930
	"	Bit.	8 679	"	13.50	15 890
	"	Semi-bit.	8 793	250b	14.20	15 900
	"	"	8 696	251b	13.14	15 890
	"	"	8 698	252b	13.70	15 860
	"	"	8 748	253b	14.08	15 990
	"	"	8 469	261b	12.30	15 900
	"	"	8 448	267b	13.00	16 000
	"	"	8 681	271b	13.20	15 870
	Raleigh	"	19 779	126c	19.30	15 800
	"	"	8 938	285b	13.50	15 870
	Fayette	"	1 595	241b	21.10	15 900
	"	"	14 386	111a	22.20	15 790
	"	"	10 629	114a	19.80	15 800
	McDowell	"	5 276	252b	14.33	15 920
	"	"	29 988	91f	19.29	15 840
	"	"	29 891	86f	19.89	15 820

TABLE 18

BITUMINOUS B COALS OF THE UNITED STATES

Unit Volatile 24 to 50 per cent
Unit B.t.u. 15 000 to 16 500

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Ala.	Tuscaloosa	Bit.	14 717	19a	26.60	15 700
	Shelby	"	18 291	22c	38.70	15 200
	Jefferson	"	12 086	17a	30.30	15 560
	"	"	16 687	17a	32.60	15 593
	"	"	....	78j	33.45	15 610
	St. Clair	"	12 443	18a	35.20	15 810
	"	"	24 377	22c	36.77	15 410
	Tuscaloosa	"	2 538	39b	26.28	15 800
Colo.	Las Animas	"	11 930	29a	34.30	15 670
	"	"	14 060	30a	35.20	15 480
	Pitkin	"	9 198	76b	36.40	15 360
	La Plata	"	14 772	27a	36.60	15 320
	Montezuma	"	12 586	34a	42.20	15 000
Ill.	Gallatin	"	23 424	34c	39.00	15 270
	"	..	....	63i	40.35	15 109
	"	..	....	68i	37.85	15 187
	"	..	....	68i	41.26	15 136
	"	..	....	68i	36.00	15 420
Ind.	Clay	Bit.	3 536	93b	40.70	15 000
	Parke	"	1 979	95b	49.30	15 010
Kan.	Cherokee	"	1 037	101b	38.60	15 570
	Crawford	"	11 184	38a	37.30	15 330
	Linn	"	2 790	102b	36.40	15 030
	Cherokee	"	1 411	101b	36.40	15 320
Ky.	Pike	"	12 004	41a	37.00	15 460
	Crittenden	"	22 895	42c	39.30	15 350
	Letcher	"	14 905	39c	38.20	15 300
	Pike	"	17 459	51c	35.60	15 220
	Harlan	"	24 732	44c	39.40	15 220
	"	"	....	287j	39.42	15 120
	Laurel	"	21 343	48c	43.70	15 110
	Letcher	"	21 298	48c	38.44	15 160
	Whitley	"	....	287j	39.40	15 110
Mo.	Barton	"	11 188	42a	35.50	15 280
	Bates	"	11 309	43a	40.30	15 100
	Henry	"	11 251	46a	46.70	15 050
Nev.	Esmeralda	"	13 980	57a	43.00	15 220
	"	"	14 409	57a	45.35	15 400
N. Mex.	Santa Fe	"	14 884	59a	29.30	15 570
	Bernalillo	"	12 650	57a	43.40	15 710
	Colfax	"	14 791	58a	44.70	15 500
	"	"	12 235	57a	41.50	15 330
	"	"	17 703	60c	43.40	15 210
	Lincoln	"	15 053	59a	44.80	15 020
Ohio	Belmont	"	2 392	145b	41.50	15 140
	"	"	20 189	65c	48.40	15 030
	Noble	"	17 215	63a	42.30	15 180
	Jefferson	"	15 394	61a	41.70	15 140
	"	"	2 083	147b	41.70	15 200
	Guernsey	"	20 263	265d	38.80	15 080
	Jefferson	"	15 565	62a	41.90	15 010
	Vinton	"	2 310	148b	41.80	15 060
Okla.	Craig	"	20 716	267d	42.00	15 460
	Rogers	"	20 780	267d	43.20	15 370
	Latimer	"	19 854	67c	38.70	15 260
	Tulsa	"	20 713	268d	42.90	15 100
	Pittsburg	"	19 858	67c	39.15	15 260
Pa.	Cambria	"	12 161	71a	24.70	15 880
	"	"	12 370	73a	24.00	15 880
	Indiana	"	12 373	93a	28.80	15 900
	Cambria	"	12 366	75a	27.50	15 690
	Indiana	"	12 223	91a	28.30	15 900
	Westmoreland	"	12 265	99a	33.10	15 560
	Fayette	"	23 097	78c	39.20	15 460
	Allegheny	"	10 845	68a	38.20	15 270

TABLE 18 (Concluded)

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Pa.	Westmoreland	Bit.	12 397	99a	39.50	15 230
	"	"	1 942	183b	33.47	15 610
	Cambria	"	30 828	65f	27.82	15 800
	Jefferson	"	17 448	78c	38.00	15 220
	Center	"	17 444	75c	25.90	15 690
	"	"	17 446	75c	26.20	15 580
	Clearfield	"	22 540	76c	26.50	15 930
	"	"	20 346	76c	26.30	15 780
	"	"	20 344	77c	27.10	15 830
	Washington	..	....	584j	39.00	15 060
Tenn.	Marion	Bit.	22 253	303d	28.30	15 780
	"	"	22 238	302d	28.90	15 600
	Hamilton	"	22 164	299d	31.50	15 600
	"	"	22 213	300d	32.20	15 500
	Sequatchie	"	22 242	317d	32.90	15 500
	Bledsoe	"	22 261	273d	32.90	15 470
	Grundy	"	22 364	297d	33.30	15 290
	Rhea	"	22 184	313d	34.40	15 500
	Morgan	"	21 415	309d	42.40	15 620
	"	"	21 418	309d	43.50	15 560
	Fentress	"	20 985	296d	40.80	15 520
	White	"	22 397	318d	44.70	15 400
	Anderson	"	21 455	269d	40.30	15 360
	Overton	"	20 981	311d	40.00	15 350
	Claiborne	"	22 091	291d	42.50	15 330
	Campbell	"	21 676	277d	38.80	15 300
	Marion	"	22 234	301d	40.20	15 290
	Claiborne	"	22 124	295c	39.90	15 200
	"	"	21 848	288d	39.40	15 180
	Campbell	"	21 856	283d	39.00	15 140
	Claiborne	"	21 852	289d	39.50	15 130
	"	"	22 099	292d	41.70	15 080
	Campbell	"	22 014	286d	41.60	15 080
	Claiborne	"	22 113	294d	40.70	15 040
	Campbell	"	21 830	281d	40.70	15 030
Va.	Henrico	Semi-bit.	15 050	106a	28.20	15 500
	Buchanan	Bit.	19 833	323d	34.10	15 640
	Wise	"	15 101	107a	34.10	15 520
	Russell	"	10 736	106a	37.70	15 570
	Wise	"	15 099	107a	37.30	15 280
	Lee	"	6 239	197b	40.30	15 030
	Russell	"	10 739	106a	38.40	15 590
	Wise	"	10 388	201b	35.70	15 410
Wash.	Pierce	"	14 390	109a	39.10	15 580
	Kittitas	"	11 526	108a	43.80	15 240
	"	"	11 525	107a	43.60	15 110
W. Va.	Preston	"	12 225	127a	28.50	15 650
	Greenbrier	"	13 547	114a	28.50	15 690
	Monongalia	"	12 204	127a	30.60	15 500
	Randolph	"	13 601	132a	33.40	15 680
	Logan	"	23 513	120c	35.20	15 580
	Fayette	"	23 992	117c	38.00	15 530
	Logan	"	23 413	119c	34.80	15 470
	Clay	"	23 594	116c	38.80	15 280
	Braxton	"	13 556	110a	45.30	15 270
	Marion	"	11 433	121a	37.80	15 260
	Marshall	"	14 488	122a	45.40	15 050
	Marion	"	1 213	273b	39.50	15 490
	Randolph	"	1 297	292b	31.84	15 700
	Kanawha	"	23 925	119c	39.50	15 220
	"	"	2 375	246b	35.38	15 590
	Mingo	"	17 488	101f	38.20	15 340
	Fayette	"	14 347	111a	25.00	15 610
	Greenbrier	"	13 547	114a	28.50	15 670
	McDowell	Semi-bit.	14 188	116a	24.10	15 800
	Monongalia	Bit.	12 204	127a	30.65	15 550

TABLE 19
BITUMINOUS C COALS OF THE UNITED STATES
Unit Volatile 30 to 55 per cent
Unit B.t.u. 14 000 to 15 000

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Ala.	Bibb	Bit.	20 135	17c	40.20	14 950
	Walker	"	24 958	23c	38.30	14 870
Cal.	Monterey	"	3 773	53b	53.00	14 580
Colo.	Las Animas	"	11 443	28a	39.00	14 880
	Gunnison	"	12 324	25a	43.60	14 740
	Delta	"	11 106	24a	42.40	14 570
	Mesa	"	11 104	33a	42.70	14 530
	Garfield	"	12 327	25a	46.10	14 480
	Mesa	"	11 109	33a	40.7	14 460
	"	"	11 108	33a	39.00	14 430
	Huerfano	"	13 529	26a	45.60	14 000
	Delta	"	5 551	56b	40.00	14 100
	Fremont	"	10 142	59b	42.10	14 100
	Garfield	"	3 729	59b	42.20	14 270
Idaho	Boise	Sub-bit.	12 703	35a	50.60	14 300
	Fremont	Bit.	15 116	36a	44.00	14 320
	"	"	15 115	36a	43.80	14 440
Ill.	Williamson	"	17 720	36c	39.00	14 720
	Franklin	"	23 478	33c	41.20	14 710
	Peoria	"	21 035	35c	45.40	14 700
	Vermilion	"	14 682	37a	45.40	14 470
	Madison	"	10 959	36a	45.40	14 400
	Montgomery	"	11 354	37a	43.20	14 390
	Williamson	"	30 876	34f	39.10	14 470
	Saline	"	7 502	90b	39.04	14 990
	Williamson	"	30 866	34f	39.71	14 596
	Franklin	"	22 921	34c	39.30	14 600
	Macoupin	"	18 910	34c	47.80	14 310
	Montgomery	"	21 906	35c	45.00	14 400
	Perry	"	20 734	35c	39.30	14 410
	Saline	"	12 795	37a	39.30	14 840
	Vermilion	"	14 682	37a	45.50	14 470
	Sangamon	..	....	166j	45.70	14 360
	Bureau	..	....	59i	48.83	14 477
	La Salle	..	....	59i	50.57	14 494
	Marshall	..	....	59i	49.06	14 796
	Grundy	..	....	59i	48.39	14 496
	Jackson	..	....	60i	39.18	14 818
	Mercer	..	....	60i	50.17	14 546
	"	..	....	166j	50.98	14 570
	Christian	..	....	60i	44.67	14 717
	Peoria	..	....	60i	47.91	14 614
	Tazewell	..	....	61i	47.96	14 496
	Logan	..	....	61i	48.05	14 400
	Fulton	..	....	61i	47.82	14 416
	Menard	..	....	61i	46.93	14 478
	Sangamon	..	....	62i	47.83	14 415
	Macon	..	....	62i	46.78	14 419
	Saline	..	....	62i	40.16	14 794
	Franklin	..	....	63i	40.82	14 538
	Williamson	..	....	64i	39.50	14 655
	Perry	..	....	64i	40.44	14 407
	Jackson	..	....	64i	41.10	14 608
	Macoupin	..	....	64i	47.72	14 388
	"	..	....	65i	47.20	14 349
	Madison	..	....	65i	48.48	14 370
	Sangamon	..	....	65i	48.05	14 329
	Montgomery	..	....	65i	46.32	14 290
	Clinton	..	....	66i	46.02	14 290
	St. Clair	..	....	66i	48.83	14 457
	Perry	..	....	66i	44.93	14 359
	Marion	..	....	67i	46.12	14 511
	Randolph	..	....	67i	46.07	14 351
	Vermilion	..	....	67i	45.60	14 575
	"	..	....	67i	48.07	14 740
	La Salle	..	....	68i	50.40	14 685
	McLean	..	....	68i	49.16	14 604
	"	..	....	68i	51.48	14 710
	La Salle	..	....	68i	52.95	14 397
	Moultrie	..	....	68i	46.10	14 882
Ind.	Sullivan	Bit.	10 960	37a	41.40	14 780
	"	"	23 227	37c	43.30	14 750
	Vermilion	"	23 217	37c	46.90	14 750
	"	"	25 349	38c	47.60	14 720

TABLE 19 (Concluded)

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Ind.	Gibson	Bit.	20 368	36c	45.00	14 740
	Green	"	3 567	93b	40.30	14 720
	Warrick	"	16 578	37a	47.00	14 660
	Sullivan	"	1 775	97b	39.78	14 620
	Knox	"	18 437	37c	45.20	14 820
	Pike	"	2 759	95b	42.50	14 800
	Sullivan	"	22 221	37c	45.40	14 840
	Vanderburg	"	20 253	"	43.30	14 520
	Vigo	"	1 960	97b	44.60	14 740
	"	"	3 748	98b	45.85	14 830
	"	"	23 117	38c	48.20	14 880
	Vermilion	"	23 217	37c	47.00	14 720
Iowa	Appanoose	"	1 323	99b	45.50	14 710
	Polk	"	1 312	100b	49.10	14 700
	Marion	"	1 289	99b	49.20	14 590
	Lucas	"	1 433	99b	40.70	14 550
	Marion	"	1 570	99b	45.00	14 640
Kan.	Leavenworth	"	12 844	39a	45.00	14 860
	Cherokee	"	1 411	101b	36.40	15 320
	Osage	..	....	266j	47.58	14 970
Ky.	Muhlenberg	Bit.	13 260	40a	44.20	14 790
	Hopkins	"	19 203	45c	45.00	14 680
	Christian	"	19 297	42c	41.20	14 670
	Ohio	"	15 102	41a	43.90	14 640
	Henderson	"	18 966	44c	44.70	14 550
	Webster	"	19 154	53c	39.68	14 950
	Hopkins	"	19 236	46c	41.51	14 595
	Union	"	19 175	52c	41.80	14 985
Mich.	Saginaw	"	7 706	113b	36.75	14 690
	"	"	255	24g	41.35	14 810
Mo.	Ray	"	11 368	51a	45.20	14 620
	Adair	"	14 799	41a	49.50	14 610
	Audrain	"	11 478	"	47.70	14 590
	Harrison	"	11 377	45a	46.70	14 470
	Lafayette	"	10 232	119b	42.70	14 500
	Sullivan	"	10 143	124b	43.80	14 730
	Henry	"	11 255	47a	43.78	14 950
Mont.	Teton	"	12 602	55a	43.40	14 100
	"	"	12 427	"	49.50	14 030
	Broadwater	"	6 62d	124b	33.80	14 850
N. Mex.	Santa Fe	"	14 885	59a	40.60	14 810
	"	"	14 887	"	47.20	14 690
	San Juan	"	17 749	62c	42.60	14 340
	McKinley	Sub-bit.	15 032	59a	45.10	14 280
	"	"	1 278	140b	42.30	14 050
Ohio	Belmont	Bit.	20 241	263d	43.90	14 970
	Guernsey	"	20 243	265d	46.00	14 930
	"	"	20 263	66c	38.80	14 960
	Belmont	"	20 238	263d	43.20	14 890
	Tuscarawas	"	4 059	148b	45.25	14 960
	Belmont	"	20 176	65c	49.85	14 990
	Guernsey	"	20 178	65c	46.05	14 910
	Hocking	"	15 189	146b	38.80	14 320
	Monroe	"	20 259	66c	43.30	14 840
	Jackson	"	2 071	146b	46.30	14 700
	Noble	"	20 235	66c	45.20	14 770
	Perry	"	2 144	147b	41.80	14 600
Okla.	Wagoner	"	20 832	69c	39.10	14 970
	Okmulgee	"	1 059	150b	41.45	14 880
Pa.	Washington	"	15 673	97a	40.40	14 970
Tenn.	Campbell	"	21 805	279d	39.80	14 970
	"	"	21 658	274d	42.20	14 940
	"	"	21 927	283d	42.10	14 720
Tex.	Maverick	"	494	39g	44.65	14 810
Utah	Carbon	"	10 906	103a	45.20	14 500
	Emery	"	12 627	104a	46.20	14 480
	Grand	"	17 577	110c	44.20	14 380
	Sanpete	"	17 715	111c	36.10	14 570
	Carbon	"	10 045	191b	45.65	14 200
Wash.	King	"	9 114	203b	44.60	14 140
	"	"	9 105	"	44.10	14 210
W. Va.	Brooke	"	15 671	110a	39.00	14 920
	Putnam	"	23 647	125c	44.30	14 970
Wyo.	Weston	Sub-bit.	16 415	146a	51.20	14 360
	Uinta	Bit.	11 568	145a	44.10	14 330
	"	"	13 519	"	44.50	14 330
	Sweetwater	"	11 465	144a	43.10	14 230
	"	"	9 73D	316b	43.80	14 110

Table 20

Bituminous D Coals of the United States

Unit Volatile 35 to 60 per cent
Unit B.t.u. 12 500 to 14 000

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Ark.	Ouachita	Lignite	2 726	49b	51.20	12 710
	"	"	2 647	48b	51.75	12 550
Cal.	Alameda	Sub-bit.	1 680	53b	52.20	13 240
	San Benito	Bit.	7 914	53b	44.40	13 510
	Mendocino	Sub-bit.	31 139	25f	56.20	13 700
Colo.	Rio Blanco	Bit.	12 426	35a	43.20	13 910
	Fremont	Sub-bit.	13 395	25a	45.50	13 910
	Moffat	"	12 400	33a	48.00	13 580
	"	Bit.	14 543	33a	47.10	13 530
	Rio Blanco	"	12 695	35a	49.90	13 480
	"	"	3 498	77b	45.10	13 690
	Moffat	"	14 909	33a	46.30	13 410
	Jackson	Sub-bit.	12 774	26a	44.50	13 030
	Jefferson	"	16 615	27a	46.20	12 590
	El Paso	"	12 099	24a	43.60	12 500
	Boulder	"	1 523	54b	45.80	13 590
	"	"	31 316	25f	43.90	13 380
	El Paso	"	6 438	57b	43.43	12 780
	Moffat	"	17 592	31c	42.50	12 710
	Routt	Bit.	6 643	81b	44.72	13 270
	Weld	"	3 63d	81b	53.90	13 310
	Weld	Sub-bit.	6 375	81b	40.20	13 400
	Moffat	"	17 696	31c	40.19	13 080
Idaho	Cassia	Lignite	12 643	36a	52.70	12 640
	Fremont	Sub-bit.	29 281	29f	42.80	13 200
Iowa	Monroe	Bit.	194	21g	43.40	13 000
Mont.	Musselshell	Sub-bit.	17 589	59c	41.50	13 960
	Carbon	"	15 150	53a	42.80	13 550
	Chouteau	"	17 790	57c	40.50	13 120
	Hill	"	17 841	59c	43.00	12 900
	Missoula	"	13 541	55a	51.30	12 520
	Carbon	Bit.	4 271	125b	40.50	13 900
	Cascade	"	3 759	127b	31.60	13 660
	Park	"	6 607	134b	41.90	13 400
	Chouteau	Sub-bit.	8 622	128b	37.69	13 575
N. Mex.	McKinley	"	19 139	62c	46.65	13 990
	San Juan	"	23 003	63c	42.30	13 575
N. Dak.	Adams	Lignite	14 542	59a	50.80	12 660
	Morton	"	20 033	262d	50.00	12 520
	McLean	"	2 243	143b	54.80	12 730
	Stark	Lignite	2 289	143b	53.00	12 790
	Williams	"	1 416	144b	48.00	12 500
	Morton	"	20 033	63c	50.15	12 530
Ore.	Coos	Sub-bit.	9 152	152b	43.00	12 990
	Clackamas	Bit.	22 492	69c	37.80	13 780
S. Dak.	Perkins	Lignite	14 354	100a	50.60	12 600
Tex.	Houston	"	1 456	189b	58.80	13 300
	Medina	Bit.	7 330	189b	49.00	12 820
	Milam	Lignite	2 734	189b	44.50	13 070
	"	"	7 270	189b	44.80	12 550
	Robertson	Bit.	7 403	190b	44.70	12 880

TABLE 20 (Concluded)

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Tex.	Wood	Lignite	1 597	190b	49.00	12 600
	"	"	2 717	190b	46.20	12 890
Utah	Iron	Bit.	5 305	193b	42.20	13 390
	Kane	"	5 341	194b	43.60	13 500
	Morgan	Sub-bit.	19 799	323d	42.20	13 400
	Summit	"	8 064	195b	44.15	13 300
	"	"	13 216	105a	49.40	13 410
	Uinta	Bit.	5 517	195b	42.70	13 590
	"	"	5 509	195b	42.15	13 930
	Summit	Sub-bit.	13 217	105a	46.72	13 140
Wash.	Lewis	"	10 324	216b	48.80	13 180
	King	"	9 169	203b	47.40	13 700
	"	"	9 168	204b	40.65	13 680
	"	"	9 323	205b	43.50	13 400
	"	Bit.	9 281	207b	46.60	13 930
	"	Sub-bit.	2 686	208b	43.70	13 900
	Lewis	"	9 177	214b	49.80	12 550
	"	"	10 324	216b	48.90	13 190
	"	....	....	835j	48.80	13 170
	Thurston	Sub-bit.	9 094	221b	45.80	12 600
	"	....	....	835j	46.78	12 910
	"	Sub-bit.	9 096	222b	44.00	12 580
	King	"	11 736	107a	47.96	13 690
Wyo.	Sweetwater	"	11 460	145a	42.30	13 980
	"	"	11 510	144a	42.30	13 720
	Hot Springs	"	15 237	135a	41.60	13 680
	Uinta	Bit.	11 730	145a	46.30	13 620
	Hot Springs	Sub-bit.	17 709	127c	45.50	13 600
	Crook	Bit.	15 714	133a	49.30	13 550
	Fremont	Sub-bit.	17 247	133a	45.00	13 160
	Sheridan	"	5 383	308b	46.50	13 800
	Sheridan	"	12 687	139a	45.70	12 810
	Johnson	"	11 059	138a	44.70	12 710
	Natrona	"	17 895	128c	43.40	12 520
	Campbell	"	22 973	126c	50.80	12 500
	Crook	Bit.	2 278	305b	48.20	13 610
	Fremont	Sub-bit.	4 354	305b	48.00	13 100
	Sheridan	"	5 386	309b	46.70	12 880
	Sweetwater	"	7 096	310b	36.65	13 000
	Uinta	"	3 390	319b	46.75	13 280
	Big Horn	"	5 766	295b	40.20	13 100
	"	"	5 778	296b	45.70	13 600
	"	"	6 709	296b	51.30	13 200
	Carbon	Sub-bit.	5 298	297b	51.10	12 720
	"	Bit.	5 446	298b	40.00	13 000
	"	Sub-bit.	3 606	299b	51.00	13 630
	"	"	3 363	300b	46.20	13 310
	"	"	3 790	301b	41.40	13 000
	"	Bit.	5 340	303b	43.60	13 480
	Hot Springs	Sub-bit.	15 235	136a	41.75	13 780
	Sheridan	"	10 825	138a	44.34	12 710
	Sweetwater	Bit.	7 091	311b	40.55	13 670

TABLE 21
LIGNITES OF THE UNITED STATES
Unit Volatile 35 to 60 per cent
Unit B.t.u. 11 000 to 12 500

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Colo.	Adams	Sub-bit.	13 141	23a	46.90	12 260
	"	"	6 833	54b	40.80	11 700
	El Paso	"	6 440	57a	45.50	12 210
	Adams	"	13 141	23a	46.90	12 230
	Jefferson	"	6 593	66b	49.00	12 320
	Larimer	"	6 433	68b	45.45	12 360
	Elbert	"	19 902	30c	48.60	12 300
	El Paso	"	7 128	57b	46.20	11 930
Mont.	Fallon	Lignite	20 370	57c	47.20	12 200
	Dawson	"	11 045	54a	41.70	11 850
	Valley	"	10 899	56a	47.20	11 700
	"	"	10 898	55a	48.50	11 700
	"	"	10 724	56a	46.00	11 690
	Chouteau	Sub-bit.	7 156	128b	40.60	12 220
	Custer	"	3 701	130b	44.00	12 200
	Rosebud	"	5 403	135b	43.20	12 180
Nev.	Mineral	"	30 792	57f	52.10	12 190
N. Dak.	Morton	Lignite	14 729	60a	53.30	12 330
	Williams	"	12 588	60a	51.20	12 140
	"	"	12 587	60a	49.50	12 000
	Billings	"	5 781	142b	56.70	11 690
	"	"	5 784	142b	49.60	11 730
	Bowman	"	7 499	142b	45.20	12 120
	"	"	14 485	59a	53.80	12 270
	Morton	"	7 839	143b	40.80	12 210
	Ward	"	7 587	143b	41.40	12 160
	Williams	"	4 276	144b	45.40	12 200
	Stark	"	1 971	143b	47.80	12 440
	Ward	"	31 705	47f	46.40	11 610
Ore.	Malheur	"	12 585	67a	45.15	12 490
S. Dak.	Harding	"	13 220	100a	48.70	11 900
	Perkins	"	12 453	100a	45.70	12 230
	"	"	12 488	"	46.80	12 490
Utah	Kane	Bit.	5 314	194b	45.00	11 500
Wash.	Lewis	Sub-bit.	9 941	214b	53.70	12 420
	"	"	9 940	215b	52.80	12 300
Wyo.	Converse	"	11 048	132a	46.70	12 490
	Weston	"	12 446	146a	45.20	12 460
	Crook	"	5 402	305b	43.20	12 220
	Johnson	"	6 469	306b	53.00	12 300
	Natrona	"	9 145	307b	46.50	11 780
	Sheridan	"	5 748	307b	53.35	11 830
	"	"	5 747	309b	47.70	12 300
	Sweetwater	Bit.	7 090	311b	43.10	11 080
	"	"	6 043	314b	40.85	12 130
	Uinta	"	4 000	319b	45.80	11 610
	Carbon	Sub-bit.	3 919	302b	44.00	11 770
	"	"	5 818	303b	45.25	12 390
	"	"	3 548	303b	43.80	12 300
	Uinta	"	3 696	320b	47.15	11 400

TABLE 22
PEATS OF THE UNITED STATES
Unit Volatile 55 to 80 per cent
Unit B.t.u. 9 000 to 11 000

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Conn.	New Haven	Peat	6155	188e	78.10	10 100
	Fairfield	"	6189	186e	82.68	10 900
	New London	"	6163	188e	67.40	9 900
	Litchfield	"	6199	187e	74.40	10 380
	Middlesex	"	6210	187e	61.40	9 500
Fla.	Duval	"	6028	189e	62.80	10 690
	Lake	"	7634	190e	67.20	10 820
	Putnam	"	7150	192e	59.80	10 520
	Dade	"	7601	189e	61.70	10 780
	Osceola	"	7154	191e	56.80	10 780
	Polk	"	7166	191e	63.60	10 920
Me.	Kennebec	"	5978	194e	73.70	8 970
	Aroostook	"	5914	193e	67.00	10 680
	Knox	"	5838	194e	68.80	9 350
	Washington	"	5933	195e	64.90	10 710
	Cumberland	"	5844	193e	67.30	9 520
	Hancock	"	5837	193e	62.50	9 940
	Oxford	"	5862	194e	62.70	9 780
	Penobscot	"	5916	195e	66.70	10 280
Mass.	Middlesex	"	6622	197e	93.30	10 370
Mich.	Kalamazoo	"	6720	197e	66.80	10 810
	Monroe	"	6299	197e	66.70	10 230
N. Hamp.	Strafford	"	6572	198e	70.00	10 810
	Rockingham	"	6571	197e	65.20	10 680
N. Y.	Livingston	"	6664	198e	69.70	9 720
	Oswego	"	6637	199e	69.77	9 950
	Essex	"	6420	198e	67.10	10 430
	St. Lawrence	"	6395	199e	69.30	10 300
N. Car.	Pasquotank	"	5585	199e	63.50	10 440
Wis.	Sawyer	"	6382	202e	66.40	10 530
	Dane	"	6278	200e	69.61	9 820
	Langlade	"	6527	201e	67.40	9 780
	Marinette	"	6515	201e	68.30	9 930
	Fond du Lac	"	6280	201e	69.58	10 100
	Vilas	"	6511	202e	71.20	10 630

TABLE 23
CANNEL COALS OF THE UNITED STATES
Unit Volatile 50 to 80 per cent
Unit B.t.u. 15 000 to 16 500

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Ky.	Johnson	Cannel	5 437	105b	56.60	16 180
	"	"	7 133	105b	54.30	16 000
	"	"	7 132	105b	56.80	15 930
	"	"	5 437	105b	57.55	15 920
Tenn.	Campbell	"	21 997	91c	55.80	15 930
Wash.	Lewis	"	12 305	108a	80.00	15 800
Utah	Kane	"	5 308	194b	66.80	15 470
W. Va.	Boone	......	....	862j	57.95	16 200
	"	......	....	861j	62.30	16 720

TABLE 24
SUB-CANNEL COALS OF THE UNITED STATES
Unit Volatile 55 to 80 per cent
Unit B.t.u. 14 000 to 15 000

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Tex.	Webb	Cannel	29 021	73f	59.15	14 810
	"	"	29 024	73f	55.70	14 720
	"	......	....	783j	57.65	14 830

TABLE 25
STRAY COALS OF THE UNITED STATES

State	County	Bureau of Mines Classification	Lab. No.	Key Reference	Unit Volatile	Unit B.t.u.
Cal.	Amador	Lignite	31 141	24f	65.70	13 200
Fla.	Lake	Peat	7 110	190e	66.00	11 320
Mont.	Dawson	"	3 817	131b	68.20	11 980
	Fergus	Bit.	5 473	131b	34.20	12 590
	Musselshell	......	....	438j	33.20	13 540
N. Mex.	Santa Fe	Anth.	14 886	59a	7.57	14 710
R. I.	Newport	"	9 328	184b	1.12	14 120
	Providence	"	3 216	185b	4.33	14 630
S. Dak.	Harding	Lignite	13 222	100a	51.00	10 870
Utah	Kane	Cannel	5 306	194b	60.60	13 870
Wyo.	Converse	Sub-bit.	5 322	304b	70.50	12 720
	Sweetwater	Bit.	6 771	313b	48.00	10 720
	"	Sub-bit.	5 375	316b	49.60	9 770
	Uinta	"	3 697	320b	49.45	9 890
	Converse	"	5 318	304b	65.20	11 480
	Sweetwater	"	5 826	311b	46.45	10 220
	"	Bit.	5 699	315b	44.20	10 680

TABLE 26

COALS OF THE WORLD EXCEPTING THOSE OF THE UNITED STATES

Country and Location	Key Reference	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Unit B.t.u.	Unit Volatile	Parr Classification
North America										
Alaska, Peninsula	41b	7.06	31.48	39.68	21.78	1.30	9 846	14 300	42.70	Bit. C
Alaska, Peninsula	41b	8.01	33.53	51.35	7.11	0.41	11 785	14 000	40.20	Bit. C
Alaska, Bering River	42b	7.77	7.40	75.59	9.24	0.66	12 569	15 300	7.81	Anth.
Alaska, Bering River	42b	7.64	9.82	76.31	6.23	0.57	13 059	15 260	10.65	Semi-anth.
Alaska, Bering River	43b	3.69	13.17	77.10	6.04	3.08	13 952	15 680	13.00	Bit. A
Alaska, Bering River	43b	5.71	8.75	80.89	4.65	1.22	14 186	15 950	8.94	Semi-anth.
Alaska, Bering River	43b	4.01	12.46	77.47	6.06	1.11	14 171	15 900	12.98	Bit. A
Alaska, Cook Inlet	44b	18.12	42.77	23.61	15.50	0.43	7 895	12 100	63.80	Stray
Alaska, Cook Inlet	45b	22.31	40.50	27.97	9.22	0.30	7 785	11 500	58.80	Lignite
Alaska, Cook Inlet	45b	19.45	34.36	29.81	16.38	0.22	7 990	12 690	52.60	Bit. D
Alaska, Matanuska	45b	6.74	14.96	65.83	12.47	0.44	11 968	15 000	17.40	Bit. A
Alaska, Matanuska	46b	2.18	30.60	58.06	9.16	0.70	13 145	15 000	33.80	Bit. B
Alaska, Admiralty Island	47b	5.68	30.26	46.95	17.11	0.26	11 203	14 580	37.60	Bit. C
Alaska, Yukon River	47b	2.10	20.81	53.99	23.10	0.62	11 230	15 400	25.80	Bit. B
Alaska, Yukon River	47b	19.75	33.13	22.72	24.40	0.17	6 266	11 990	56.55	Lignite
Canada, Alberta, Coalspur	1125j	3.70	33.20	51.70	11.40	0.20	11 400	13 580	38.42	Bit. D
Canada, Alberta, Coalspur	33l	11.90	31.70	44.30	12.10	0.20	10 320	13.770	48.60	Bit. D
Canada, Alberta, Commerce	1126j	9.60	32.80	47.80	9.80	0.50	10 640	13 330	40.00	Bit. D
Canada, Alberta, Crowsnest	29l	2.10	23.10	58.60	16.20	0.50	12 400	15 420	26.95	Bit. B
Canada, Alberta, Edmonton	1126j	4.40	31.40	53.90	10.30	0.10	11 410	13 500	36.20	Bit. D
Canada, Alberta, Drumheller	57l	19.60	30.50	43.80	6.10	0.60	9 610	13 050	40.50	Bit. D
Canada, Alberta, Frank	57l	1.20	26.00	56.30	16.50	0.60	12 330	15 220	30.40	Bit. B
Canada, Alberta, Mt. Park	1126j	0.90	29.90	63.80	5.40	0.40	14 310	15 320	31.50	Bit. B
Canada, Alberta, Rosedale	1126j	16.50	33.60	43.40	6.50	0.40	9 650	12 600	43.00	Bit. D
Canada, British Columbia, Crowsnest	1126j	4.00	28.00	64.50	7.50	0.60	13 990	15 920	31.00	Bit. B
Canada, British Columbia, Cumberland	1126j	1.10	29.60	58.10	11.20	0.50	12 960	15 100	33.30	Bit. B
Canada, New Brunswick	90k	1.13	31.80	52.75	14.23	5.73	12 750	15 500	35.40	Bit. B
Canada, New Brunswick, Minto	1126j	1.20	31.70	53.80	13.30	6.60	13 020	15 690	37.90	Bit. B
Canada, Nova Scotia, Cape Breton Co.	90k	3.70	35.00	54.20	7.02	2.79	13 150	14 910	37.40	Bit. C
Canada, Nova Scotia, Glengarry	1126j	3.90	32.60	48.70	14.80	1.30	11 930	14 950	39.00	Bit. C
Canada, Nova Scotia, Inverness Co.	1126j	3.50	37.50	45.60	13.40	5.70	11 540	14 230	44.50	Bit. C
Canada, Nova Scotia, Spring Hill	1126j	9.20	31.00	56.00	3.80	1.10	11 600	13 400	35.20	Bit. D
South America										
Brazil, Parana	1127j	2.62	29.54	38.62	29.22	11.80	10 420	16 580	37.80	Bit. B
Brazil, Rio Grande do Sul	1127j	6.05	29.09	41.33	23.53	4.00	10 715	15 870	38.60	Bit. B
Brazil, Santa Catharina	1127j	1.02	25.22	38.98	34.78	2.28	10 420	17 100	35.80	Stray
Brazil, Santa Catharina	1127j	5.34	29.68	38.71	26.23	3.90	9 692	14 780	40.50	Bit. C

TABLE 26 (Continued)

Country and Location	Key Reference	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Unit B.t.u.	Unit Volatile	Parr Classification
South America (Continued)										
Chile, Concepcion Prov.	584k	8.30	34.33	50.09	7.26	2.86	11 380	13 680	39.60	Bit. D
Chile	584k	3.93	34.42	59.59	2.05	0.68	13 664	14 600	36.40	Bit. C
Chile	584k	3.71	35.70	55.79	4.79	0.64	13 403	14 700	38.60	Bit. C
Europe										
Bulgaria	754k	0.72	36.05	56.43	5.30	3.01	12 690	13 650	37.50	Bit. D
Bulgaria	754k	11.32	44.55	26.53	17.57	3.59	7 650	11 040	61.60	Lignite
Bulgaria, Isker Valley	1128j	4.81	1.50	72.07	21.61	0.57	9 300	11 630	....	Stray
Bulgaria, Tcham-dere Basin	1128j	7.43	22.85	65.10	4.62	1.28	10 600	12 280	25.60	Stray
England, Durham, Horden	1128j	1.50	34.68	59.15	3.80	0.87	13 330	14 140	36.20	Bit. C
England, Leicester, Nailstone	1129j	13.22	30.99	50.52	5.27	1.25	13 170	16 290	38.05	Bit. B
England, Staffordshire	1129j	1.90	31.30	64.30	1.50	1.00	14 402	14 980	32.10	Bit. C
England, Warwick, Arley	1129j	12.17	32.36	52.70	2.02	0.75	11 115	13 000	37.40	Bit. D
England, Warwick, Newdigate	1129j	7.10	37.60	50.60	3.90	0.80	11 400	12 850	41.90	Bit. D
England, Yorkshire, Dalton	1129j	0.68	35.28	62.95	2.46	0.63	14 358	14 890	36.10	Bit. C
England, Yorkshire, Dearne Valley	1129j	8.44	37.01	51.19	2.00	1.36	13 397	15 020	40.60	Bit. B
Germany, Ruhr	188n	2.07	15.12	76.60	6.21	0.85	14 085	15 480	15.72	Bit. A
Germany, Rhenish	188n	3.93	16.60	70.23	9.24	1.00	13 374	15 600	18.30	Bit. A
Germany, Saar	188n	1.73	33.16	57.54	7.57	0.94	13 896	15 450	35.90	Bit. B
Germany, Saar	188n	3.88	31.20	53.08	11.84	0.81	12 420	14 790	35.70	Bit. C
Germany, Saar	188n	5.42	39.20	47.94	7.44	1.15	12 240	14 190	44.45	Bit. C
Germany, Westphalia	14o	0.30	6.00	87.60	6.10	0.90	14 080	15 100	5.90	Anth.
Germany, Westphalia	14o	0.80	12.40	79.50	7.30	1.40	13 940	15 300	12.42	Bit. A
Germany, Westphalia	14o	1.20	21.80	68.30	8.70	0.80	13 445	15 080	23.40	Bit. A
Germany, Westphalia	14o	2.60	29.20	64.20	4.00	0.80	13 760	14 810	30.80	Bit. C
Germany, Nieferlausitz	15o	52.00	25.70	18.90	3.40	0.30	4 063	9 170	57.30	Peat
Germany, Rheinland	15o	59.70	20.10	17.60	2.60	0.20	3 404	9 080	53.00	Stray
Germany, Hessen-Nassau	15o	50.70	27.00	19.00	4.30	0.30	4 021	9 000	59.70	Peat
Germany, Saxony	941k	5.60	35.00	56.94	2.46	0.60	13 284	14 500	37.80	Bit. C
Germany, Saxony	941k	8.17	35.93	53.75	2.15	0.76	12 728	14 230	39.80	Bit. C
Germany, Saxony	941k	12.10	26.22	59.73	1.95	0.96	12 316	14 390	30.15	Bit. C
Germany, Saxony	941k	9.76	36.29	52.99	0.96	0.84	12 593	14 140	40.50	Bit. C
Germany, Saxony	941k	7.22	35.97	55.33	1.48	0.57	13 199	14 480	39.20	Bit. C
Germany, Saxony	941k	12.87	21.75	63.52	1.86	0.36	12 191	14 310	25.30	Stray
Germany, Saxony	941k	6.01	30.56	57.37	7.06	0.74	12 530	14 510	34.60	Bit. C
Germany, Saxony	941k	5.41	31.30	53.53	9.75	1.44	12 310	14 700	36.00	Bit. C
Germany, Saxony	941k	53.73	23.21	18.08	4.98	1.70	4 176	10 230	55.40	Peat
Germany, Saxony	941k	53.12	25.31	18.08	3.49	0.39	4 572	10 620	58.00	Peat
Germany, Saxony	941k	14.42	44.63	33.85	7.10	1.17	8 872	11 400	56.50	Lignite
Germany, Saxony	941k	55.52	21.60	19.07	3.81	0.76	3 908	9 700	52.50	Peat
Germany, Saxony	941k	14.26	43.17	34.05	8.52	1.24	8 793	11 500	55.40	Lignite
Germany, Saxony	941k	51.31	25.80	17.97	4.92	2.04	4 347	10 050	58.20	Peat

TABLE 26 (Continued)

Country and Location	Key Reference	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Unit B.t.u.	Unit Volatile	Parr Classification
Europe (Continued)										
Scotland, Ayrshire	1130j	6.86	36.65	51.56	4.14	0.79	12 422	14 010	40.80	Bit. C
Scotland, Edinburgh	1130j	9.87	31.32	55.02	3.43	0.36	12 915	14 940	35.80	Bit. C
Scotland, Edinburgh, Penicuik	1130j	9.50	33.59	53.38	2.94	0.59	13 041	14 960	38.00	Bit. C
Scotland, Haddington	1130j	9.98	32.84	52.13	4.65	0.40	12 100	14 250	38.15	Bit. C
Scotland, Lanark, Coalburn	1130j	7.50	31.56	56.68	4.04	0.22	13 690	15 540	35.25	Bit. B
Scotland, Fifeshire	379m	2.91	26.13	67.75	2.42	0.79	13 575	14 390	27.20	Stray
Scotland, Fifeshire	379m	4.53	25.24	66.74	2.99	0.50	14 400	15 620	27.00	Bit. B
Scotland, Fifeshire	379m	2.52	7.73	87.25	2.02	0.48	11 160	11 700	7.76	Stray
Jugo Slavia (Serbia)	1130j	1.27	29.43	51.32	17.90	1.00	11 730	14 800	34.95	Bit. C
Jugo Slavia (Serbia)	1130j	3.82	40.73	42.07	13.41	1.72	11 300	13 900	48.20	Bit. D
Jugo Slavia (Serbia)	1130j	7.20	25.58	45.63	21.59	0.46	8 090	11 640	34.20	Lignite
Wales, Aberdare Merthyr	1130j	1.16	10.25	84.72	3.87	0.70	14 553	15 400	10.25	Semi-anth.
Wales, Amman District	1130j	2.73	5.84	88.31	3.12	0.79	14 482	15 480	5.64	Anth.
Wales, Gwendraeth District	1130j	2.12	6.19	89.23	2.46	0.74	14 697	15 450	6.02	Anth.
Wales, Loughbor District	1131j	2.30	5.24	90.40	2.06	0.78	14 569	15 250	5.02	Anth.
Wales, Monmouthshire	1131j	1.29	27.86	65.84	5.01	0.92	14 438	15 500	29.20	Bit. B
Wales, No. 2 Rhondda	1131j	1.32	16.01	77.54	5.13	1.21	14 350	15 450	16.35	Bit. A
Wales, No. 2 Rhondda	1131j	3.28	29.76	55.20	11.76	1.39	13 615	16 250	35.15	Bit. B
Wales, No. 2 Rhondda	1131j	1.48	22.46	65.47	10.59	2.19	13 982	16 110	24.10	Bit. B
Wales, No. 3 Rhondda	1131j	1.68	32.42	60.78	5.12	0.79	14 233	15 340	34.30	Bit. B
Wales, Pembrokeshire District	1131j	4.05	6.18	87.61	2.16	1.21	14 346	15 370	5.95	Anth.
Wales, Port Talbot	1131j	2.41	11.65	70.49	15.45	1.01	13 124	16 260	12.48	Bit. A
Wales, Rhondda & L. Aberdare	1131j	1.06	13.60	80.80	4.54	0.89	14 897	15 870	13.76	Bit. A
Wales, Swansea	1131j	2.70	16.13	72.73	8.44	1.07	13 240	15 020	17.62	Bit. A
Wales, Cardiff	1130j	1.04	17.17	76.53	5.26	0.86	14 479	15 540	17.68	Bit. A
Wales, Neath	1131j	1.83	7.47	86.82	3.88	0.79	14 574	15 520	7.32	Anth.
Asia										
British North Borneo	90k	11.48	40.24	46.70	1.58	0.36	12 000	13 820	44.10	Bit. D
China, Chi-Li	179k	1.13	22.49	66.69	9.69	0.52	12 965	14 650	24.30	Stray
China, Chi-Li	179k	3.45	8.85	85.42	2.28	1.17	10 098	10 600	8.69	Stray
China, Chi-Li	182k	1.95	28.80	51.40	17.85	0.65	12 075	15 380	34.60	Bit. B
China, Shan-Tung	183k	2.01	30.60	51.23	16.16	1.22	11 790	14 700	48.60	Bit. C
China, Shan-Tung	186k	1.74	37.39	58.89	1.98	2.23	13 662	14 300	38.30	Bit. C
China, Chi-Li-Sheng	205k	5.89	30.61	57.30	6.20	0.78	11 286	12 930	34.30	Bit. D
China, Chi-Li-Sheng	205k	8.33	35.52	48.63	7.52	1.44	10 494	12 480	41.30	Lignite
China, Chi-Li-Sheng	206k	17.44	34.30	43.59	4.17	0.48	9 108	11 760	43.70	Lignite
China, Chi-Li-Sheng	207k	15.73	37.39	40.19	7.05	1.55	9 603	12 550	47.70	Bit. D
Federated Malay States	349k	18.23	35.50	41.19	5.08	0.38	9 839	12 900	49.70	Bit. D
Japan, Chihuko	331k	4.21	42.92	45.71	7.33	0.68	12 965	14 780	48.10	Bit. C
Japan, Haporo	313k	14.29	42.95	40.13	2.63	0.27	9 801	11 820	51.50	Lignite
Japan, Karatsu	340k	3.03	42.71	46.15	8.11	2.51	12 662	14 430	47.30	Bit. C

TABLE 26 (Concluded)

Country and Location	Key Reference	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur	B.t.u.	Unit B.t.u.	Unit Volatile	Parr Classification
				Asia (Continued)						
Japan, Zioban	319k	12.24	40.61	36.11	11.04	1.02	9 759	12 900	52.20	Bit. D
Japan, Taka-Shima	343k	1.16	38.83	54.43	5.58	0.82	12 974	14 010	41.20	Bit. C
Japan, Takasaka-Zioban	15169[1]	Dry Coal	45.04	35.16	19.80	4.82	11 439	15 212	53.35	Cannel
Japan, Zioban Mine	15170[1]	"	43.49	54.26	2.25	0.50	15 145	15 543	45.30	Bit. B
Japan, Bibai Mine	15171[1]	"	45.66	50.33	4.01	0.61	14 112	14 827	47.30	Bit. C
Japan, Bibai Mine	15172[1]	"	43.77	49.70	6.53	0.46	13 593	14 739	46.40	Bit. C
Japan, Yubari Mine	15173[1]	"	45.22	48.08	6.70	0.40	14 620	15 777	48.20	Bit. B
Japan, Bibai Mine	15174[1]	"	41.48	45.14	13.38	0.40	12 553	14 686	47.20	Bit. C
Japan, Takasaka Mine	15175[1]	"	50.57	33.97	15.46	2.24	12 524	15 121	58.80	Cannel
Japan, Yubari Mine	15176[1]		46.10	51.14	2.76	0.30	15 246	15 742	47.30	Bit. B
Japan, Chiyoda Mine	15177[1]		48.72	44.93	6.35	0.44	12 227	13 136	51.70	Bit. D
Manchuria	244k	7.44	22.40	61.31	8.86	0.62	9 900	11 930	26.00	Stray
Manchuria	260k	1.28	29.00	47.02	22.70	0.16	10 845	14 610	36.60	Bit. C
Manchuria	271k	7.95	40.80	47.00	4.25	0.75	12 276	14 050	46.10	Bit. C
				Africa						
South Nigeria	385k	11.81	44.86	29.48	13.85	1.10	9 724	13 300	61.00	Stray
Natal	South	1.60	27.10	60.05	11.25	1.51	13 400	15 600	30.00	Bit. B
Natal	African	1.55	30.35	58.70	9.40	1.26	13 840	15 700	33.20	Bit. B
Natal	Journal	2.83	25.93	60.64	10.60	1.58	12 334	14 440	28.53	Stray
Natal	of	1.42	28.04	62.28	8.26	1.67	13 707	15 350	29.80	Bit. B
Natal	Industries,	1.53	23.10	68.08	7.35	1.71	13 197	15 420	24.07	Bit. B
Transvaal	May,	1.88	33.41	51.85	12.86	1.24	12 421	14 805	37.96	Bit. C
Transvaal	1923.	2.60	28.28	57.93	11.19	1.26	12 255	14 410	31.51	Bit. C
Transvaal		1.93	29.98	57.61	10.48	1.29	12 702	14 800	33.05	Bit. C
Transvaal		1.28	23.70	67.06	7.96	1.24	13 720	15 270	25.01	Bit. B
Transvaal		1.81	25.47	58.07	14.65	0.84	11 960	14 550	29.13	Stray
Transvaal		2.48	28.46	57.44	11.62	1.40	12 232	14 440	31.88	Bit. C
Transvaal		2.57	29.16	57.68	10.59	0.42	12 392	14 425	32.45	Bit. C
				Australia						
New South Wales	14k	1.89	41.35	50.51	6.25	1.01	12 760	14 000	41.50	Bit. C
New South Wales	14k	2.05	32.31	53.08	12.56	0.67	11 520	13 650	36.90	Bit. D
Western Australia	68k	21.18	28.99	43.73	6.10	0.53	9 637	13 350	39.30	Bit. D
New Zealand	77k	0.70	16.68	77.68	4.95	0.30	14 195	15 890	17.20	Bit. A
New Zealand	77k	8.22	41.50	49.71	0.57	0.45	12 812	14 070	45.40	Bit. C
New Zealand	77k	1.27	42.36	54.24	2.13	0.23	14 895	15 450	43.70	Bit. B
Tasmania, Avoca	1136j	2.00	24.00	63.00	12.00	0.00	12 062	14 170	27.00	Stray

[1]Laboratory numbers, samples analyzed Chemistry Department, University of Illinois.

Appendix A

Explanation of the Factor 5000 S

In the first place it should be borne in mind that the purpose of the formula is to arrive at the actual weight of unit coal, and to derive the actual heat per unit weight to be credited to this material. Therefore, for this particular purpose, sulphur must be eliminated.

The expression 5000 S has been used as indicating the heat of combustion of the sulphur, rather than 4050, for the reason that the latter value represents the heat of combustion of pure sulphur, while the former combines the heat of combustion of pyrites, FeS_2, which should include the heat of formation of iron oxide, Fe_2O_3, to give the figure desired.

According to Somermeier,* in the combustion of coal with known weights of iron pyrites, the indicated heat per gram of sulphur so combined is 4957 calories. In calculating heat values the correction introduced for the combinations resulting from calorimeter reactions as compared with open air combustion is 2042 calories per gram of pyritic sulphur. Hence 4957-2042, or 2915 calories (5247 B.t.u.), represents the heat due to the burning of one gram of sulphur in pyritic form instead of 2250 calories (4050 B.t.u.), the amount which would be credited to sulphur in the free condition. A strict application of these values, therefore, would call for a correction of 5247 S as representing the heat to be subtracted for the sulphur. This would imply that all of the sulphur is in pyritic form but, since a certain portion is always present in organic or other form of less heat producing capacity, it is deemed more nearly correct to use an even factor of 5000 as representing the heat to be credited to unit amounts of the total sulphur present.

*Jour. Amer. Chem. Soc., 26,566.

Appendix B

Bibliography of the Development of Methods of Classifying Coals

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